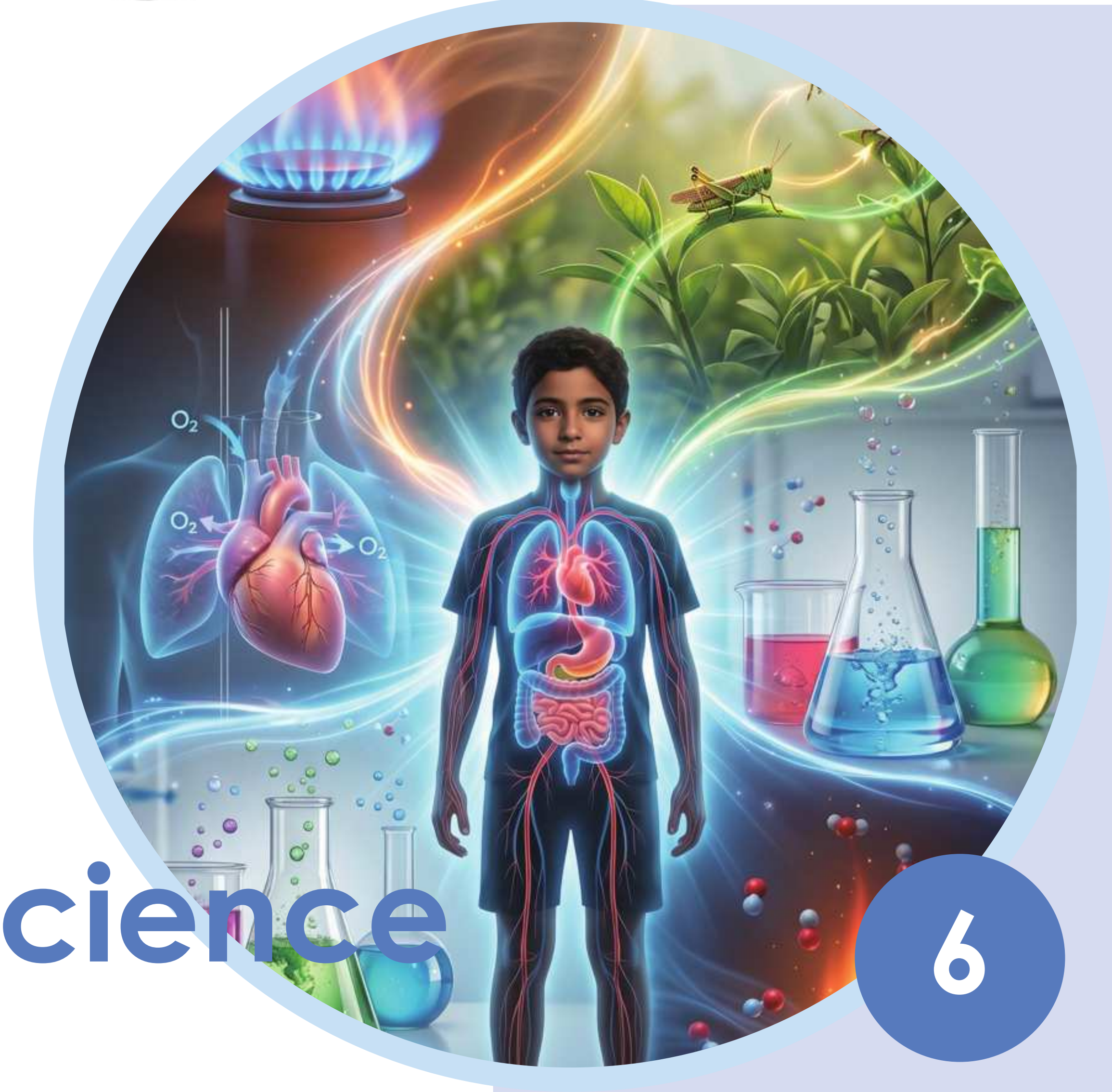
The Ministry of Education and Technical Education dedicates
this book with love to the students, teachers, and families of
the Arab Republic of Egypt



Science

6

Primary Stage - Grade 6

First Term

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Class:

School:

Supervised by: Central Administration for Curriculum Development

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Introduction

It is with great honor that we present this new science textbook for Egypt. This textbook is designed to lay a strong foundation of academic skills that will empower Egypt's next generation to thrive and contribute meaningfully to the society of tomorrow.

We, **SPRIX Inc.**, are a comprehensive education company based in Japan, committed to delivering high-quality education to children worldwide under our philosophy, **"Education Springs New Life."** As part of this mission, we have gained significant insights by understanding and analyzing the current state of fundamental academic skills within Egypt through **TOFAS (Test of Fundamental Academic Skills).**

Drawing on the valuable insights from TOFAS and inspired by the rigor and structure of the Japanese science curriculum, we have carefully tailored this textbook to suit the unique educational context of Egypt. It is structured to support a gradual and thorough development of scientific knowledge, spanning five core domains: **Life Science, Earth Science, Physical Science, Chemical Science.**

Our goal is for students to cultivate a scientific mindset and to acquire the ability to think logically and apply scientific concepts not only in daily life but also across various academic disciplines.
We sincerely hope that this textbook becomes a valuable companion in the learning journey of every student, making the study of science both meaningful and enjoyable.

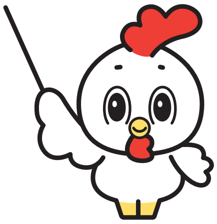
Hiroyuki Tsuneishi
President and CEO
SPRIX Inc.

Let’s Learn Together!

Characters:

Brainy

Smarty



Genius

Primary 6
Science

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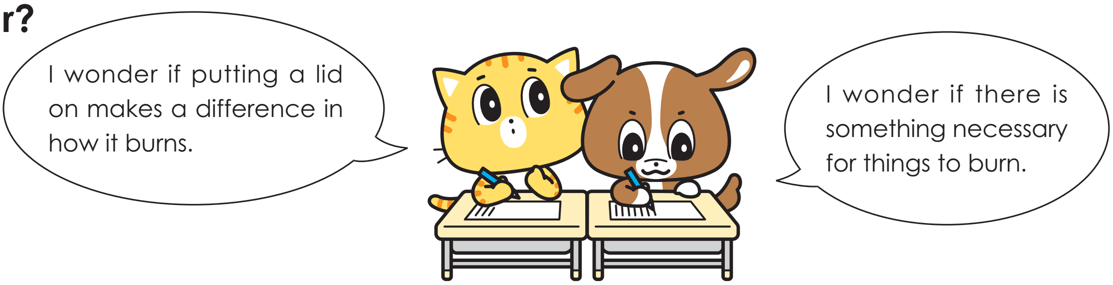
1-1 How Things Burn and Air

Chapter 1 ····· Conditions for Burning

What will happen to the candle's flame inside if you put a lid on the jar?


I wonder if putting a lid on makes a difference in how it burns.
I wonder if there is something necessary for things to burn.

Point! Air Passages and Burning

For things to keep burning, fresh **air** must constantly flow in and out. In a place where the air is not replaced, things **cannot keep burning**.

Experiment of burning things inside a jar

- **When not covered with a lid:**

  Fresh air is supplied from the surroundings, so the candle **keeps burning**.

- **When covered with a lid:**

  Once the air inside the jar is used up, the flame will **go out**.

Warm Up Let's keep things burning in various ways!

Let's do an experiment about how air works when things burn.

1 Preparation:

- Wooden board
- Clay
- Candle
- Candle stand
- Bottomless gas jar
- Metal lid
- Lighter
- Waste tray

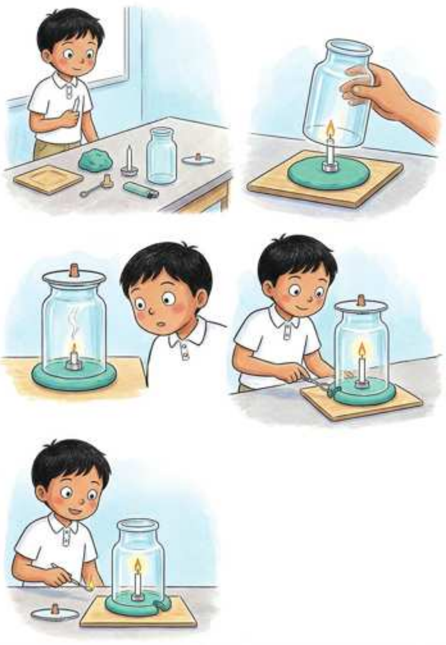
2 Experiment:

- Spread the clay flat on the board.
- Stand a candle on the clay, light it, and cover it with the bottomless gas jar.

❶ What happens to the flame when you put a lid on the jar?

❷ What happens when you cut the clay to create a gap at the bottom?

❸ What happens when you take off the lid to make gaps at both the top and bottom?

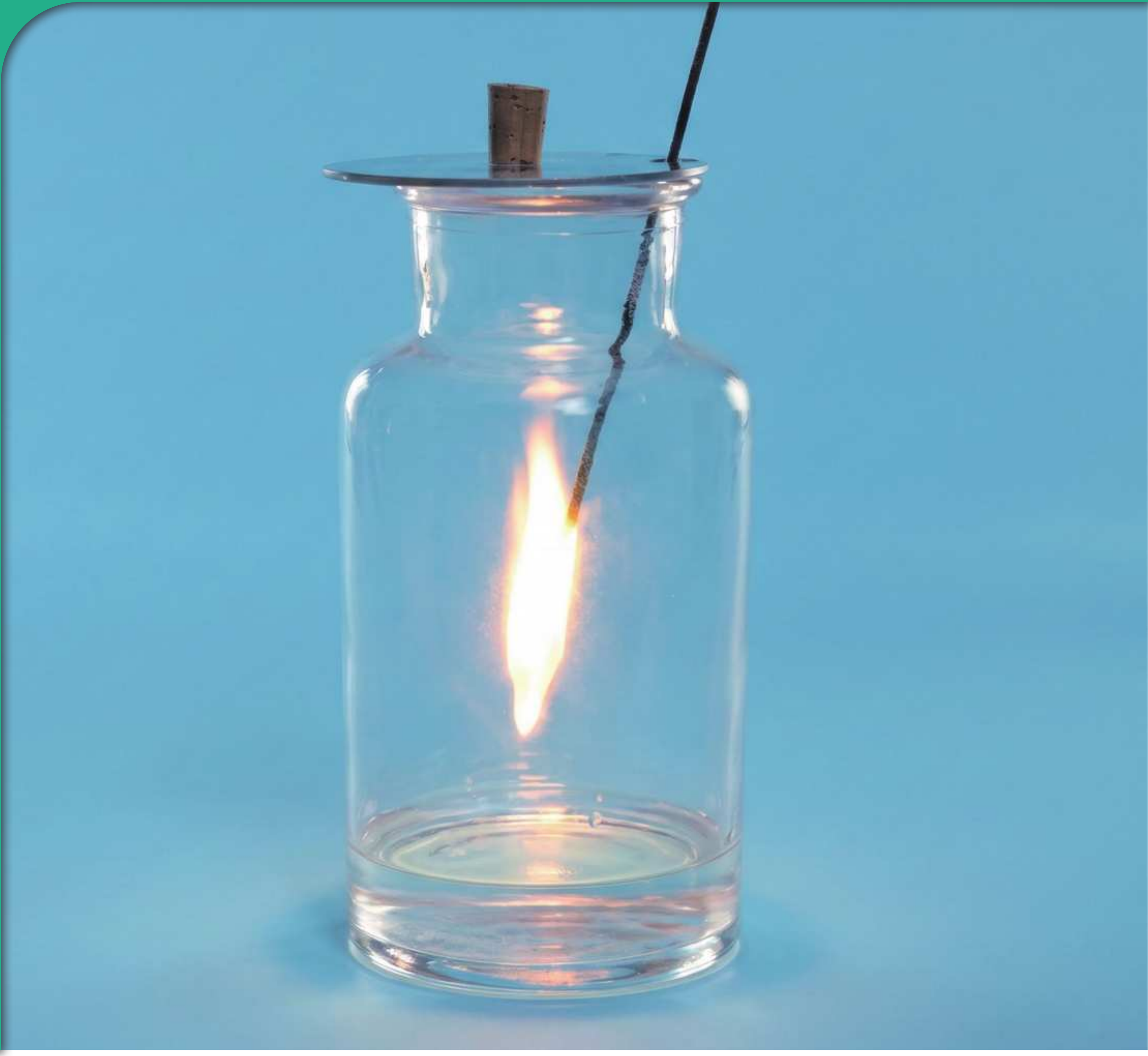


3 Summary:

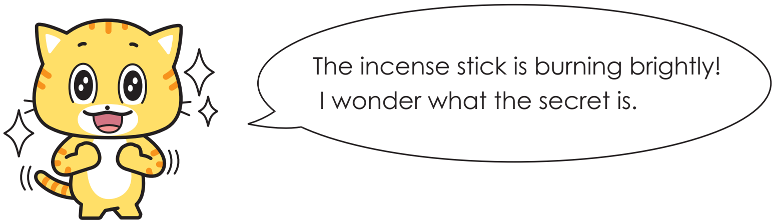
- Summarize how the candle burns and how the air moves for each of ❶ to ❸.

1-2 The Role of Oxygen

Chapter 1 ····· Conditions for Burning



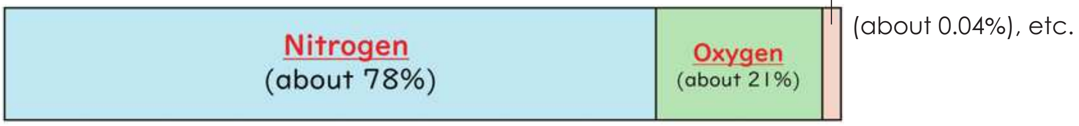
Which gas in the air helps things burn?


The incense stick is burning brightly!
I wonder what the secret is.

Point! Gases That Help Things Burn

Air is a mixture of gases like **nitrogen**, **oxygen**, and carbon dioxide.

▼Components of Air



Oxygen has the power to help things burn, but **nitrogen** and **carbon dioxide** do not.

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Warm Up Let's see the differences in burning caused by different gases!

Let's investigate which gas has the power to help things burn.

1 Preparation:

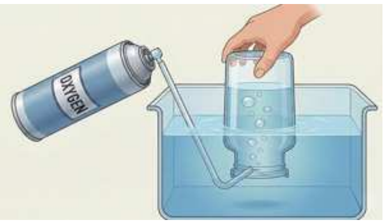
- Nitrogen gas cylinder
- Carbon dioxide gas cylinder
- Water tank filled with water
- Combustion spoon
- Oxygen gas cylinder
- 3 gas jars
- Bendy straw
- Gas lighter
- 3 lids
- Candle

2 Experiment:

❶ Put nitrogen, oxygen, and carbon dioxide into the 3 jars, respectively.

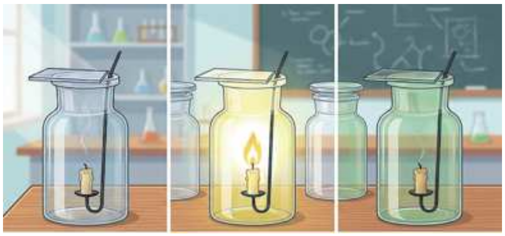
How to collect the gas

Turn the water-filled jar upside down in the water, fill 70% of it with the gas, and put the lid on.



❷ Stand a candle on the combustion spoon, light it, quickly put it into the jar, and put the lid on.

❸ Observe how the candle's flame burns.



3 Summary:

- Summarize the state of the candle and flame in each of the three jars.

Try

1 (1) In the experiment of burning a standing candle inside a jar, what happens to the flame if you put a lid on the jar to stop air from coming in and out?

(2) Why did the flame go out inside the jar with the lid? Choose the correct answer from below.

A: Because there was no water vapor in the jar.

B: Because it got dark inside the jar.

C: Because fresh air stopped coming in.

2 (1) What gas is included in the air and has the power to help things burn?

(2) What happens to the burning when you put a lit incense stick into a jar of oxygen? Choose the correct answer from below.

A: It becomes weaker.

B: It burns brightly.

C: The flame goes out.

(3) What happens to the burning when you put a lit incense stick into a jar of carbon dioxide? Choose the correct answer from below.

A: It keeps burning as it is.

B: It burns brightly.

C: The flame goes out.

Exercise

1 (1) In the experiment of burning a candle inside a jar, what happens to the flame if you leave gaps at the top and bottom of the jar? Choose the correct answer from below.

A: It keeps burning.

B: It goes out immediately.

(2) Fill in the blanks with the correct words.

For things to keep burning, fresh (①) must constantly flow in and out.

In a place where air is not replaced, things (②) keep burning.

2 (1) What happens to the burning when you put a lit incense stick into a jar of nitrogen? Choose the correct answer from below.

A: It keeps burning as it is.

B: It burns brightly.

C: The flame goes out.

(2) Which statement correctly explains oxygen? Choose the correct answer from below.

A: Oxygen makes up about 78% of the air.

B: Oxygen helps other things burn.

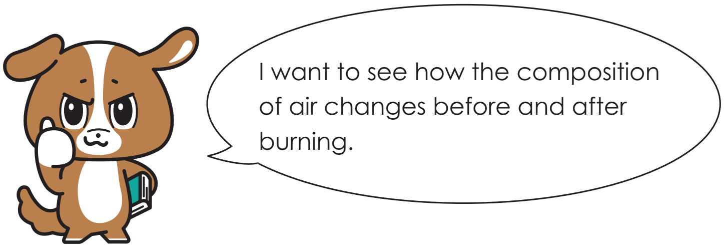
C: When you put a candle in a jar with oxygen, the flame goes out immediately.

1-3

Air After Burning

Chapter 1 ····· Conditions for Burning

What kind of changes happen to the air after things burn?


I want to see how the composition of air changes before and after burning.

Point! Changes in Air Composition After Burning

When things burn, a part of the oxygen in the air is used, and carbon dioxide is produced.

- **Oxygen**:

  The amount decreases because it is used when things burn.

- **Carbon dioxide**:

  The amount increases because it is newly produced when things burn.

Limewater

- We use **limewater** to check if there is carbon dioxide.
- Colorless and clear limewater has a property of **turning milky white** when it reacts with carbon dioxide.

Warm Up Let's check the change in air with limewater!

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Let's find out what has increased in the air after burning.

1 Preparation:

- 2 gas jars
- Limewater
- Lids
- Safety goggles
- Candle
- Combustion spoon
- Gas lighter

2 Experiment:

❶ Put limewater into each of the 2 jars.

❷ Put a lit candle into one jar, put the lid on, and wait until the flame goes out.

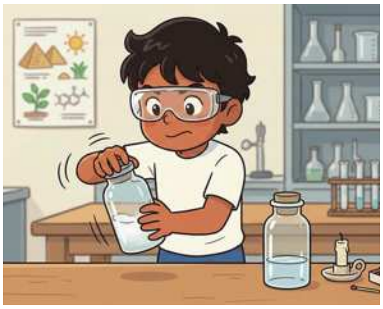
❸ After taking out the candle, shake the 2 jars.

[Caution!]

- Wear safety goggles so the limewater doesn't get in your eyes.

3 Compare:

Let's check the color change of the limewater in the 2 jars.



Try

(1) Answer the following questions about the air after things burn.

① What gas has increased?

② What gas has decreased?

(2) What is the colorless and clear liquid used to check if there is carbon dioxide?

Exercise

(1) What happens when you put limewater in a jar with increased carbon dioxide and shake it? Choose the correct answer from below.

A: It turns blue.

B: It turns yellow.

C: It turns milky white.

(2) How does the amount of oxygen change after burning?

(3) How does the amount of carbon dioxide change after burning?

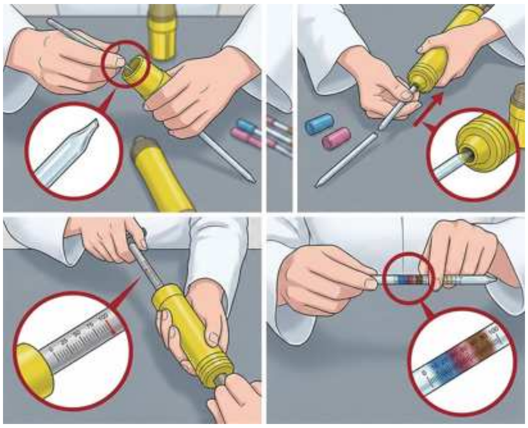
Let’s Expand!

What kind of tools are there to check gases?

1 Gas Detector Tube

- Inside the glass tube, there is a chemical that changes color when it reacts to a specific gas.
- By reading the scale where the color has changed, you can measure the amount of the gas.
- The type of tube to use is different for oxygen and carbon dioxide.

How to use



❶ Ask your teacher to break off both ends of the glass tube, then insert it firmly into the gas sampling pump.

❷ Pull the handle of the pump fully, and wait for a certain amount of time. Then, the chemical inside reacts and changes color.

❸ Read the number at the border where the color changed. This is the percentage of that gas included in the air.

[Caution!]

- The glass tube is single-use only. Also, be careful not to get hurt by the broken ends.

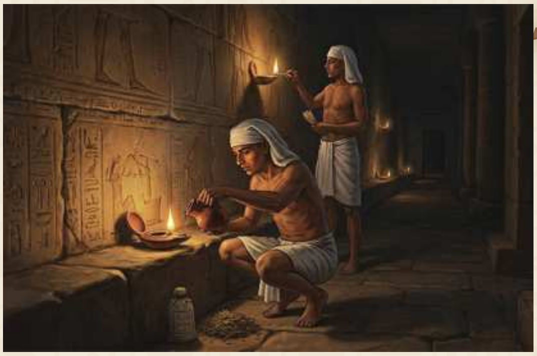
2 Gas Monitor

- It uses a sensor to show the percentage (%) of the gas on the screen in digital numbers.
- There are types that can measure both oxygen and carbon dioxide at the same time, which is very useful.

Chapter 1 Column: Combustion and Future Energy

1 The Discovery of Fire and Egyptian Civilization

Learning to use fire was a major step for human civilization. In Chapter 1, we learned that things need oxygen to burn.

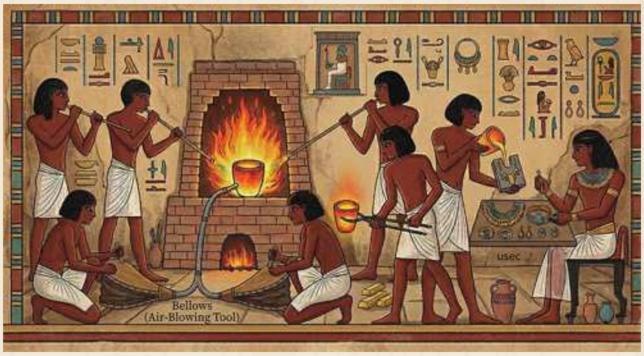


● Ancient "Lights":

Ancient Egyptians developed practical ways to use fire to light temples and tombs. Their lamp designs allowed air to reach the flame, which, as we learned, is essential for burning. This shows that even without scientific knowledge, ancient wisdom from daily life naturally matched the rules of science.

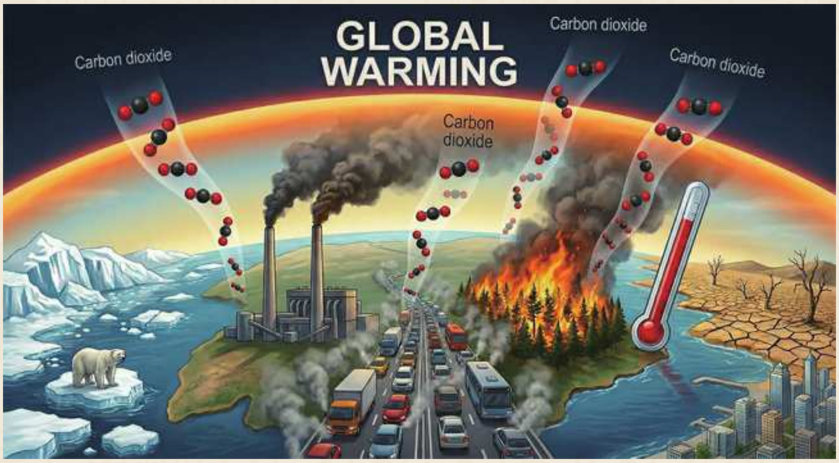
● The Role of Oxygen in Combustion:

When there is plenty of oxygen, things burn intensely. Ancient craftspeople used a bellows (a tool for blowing air) to pump air into the fire to supply more oxygen, melting gold at high temperatures to make beautiful jewelry.



2 Ways to Reduce Carbon Dioxide Emissions

Burning things produces carbon dioxide. Today, too much of this gas is one of the causes of “global warming”.

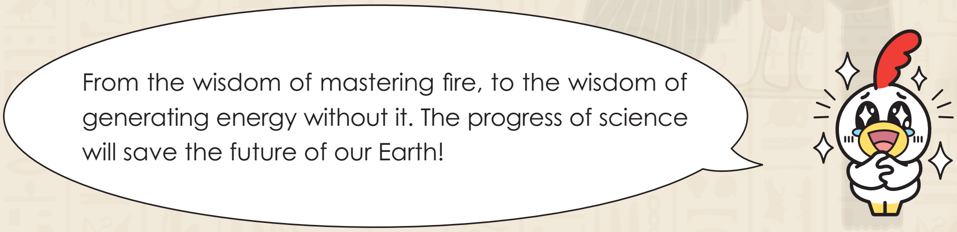

GLOBAL WARMING
Carbon dioxide
Carbon dioxide
Carbon dioxide
Carbon dioxide

- **Energy Without Burning:**

Instead of burning oil and coal, Egypt is now gaining attention from around the world for using “renewable energy” from the sun and wind.

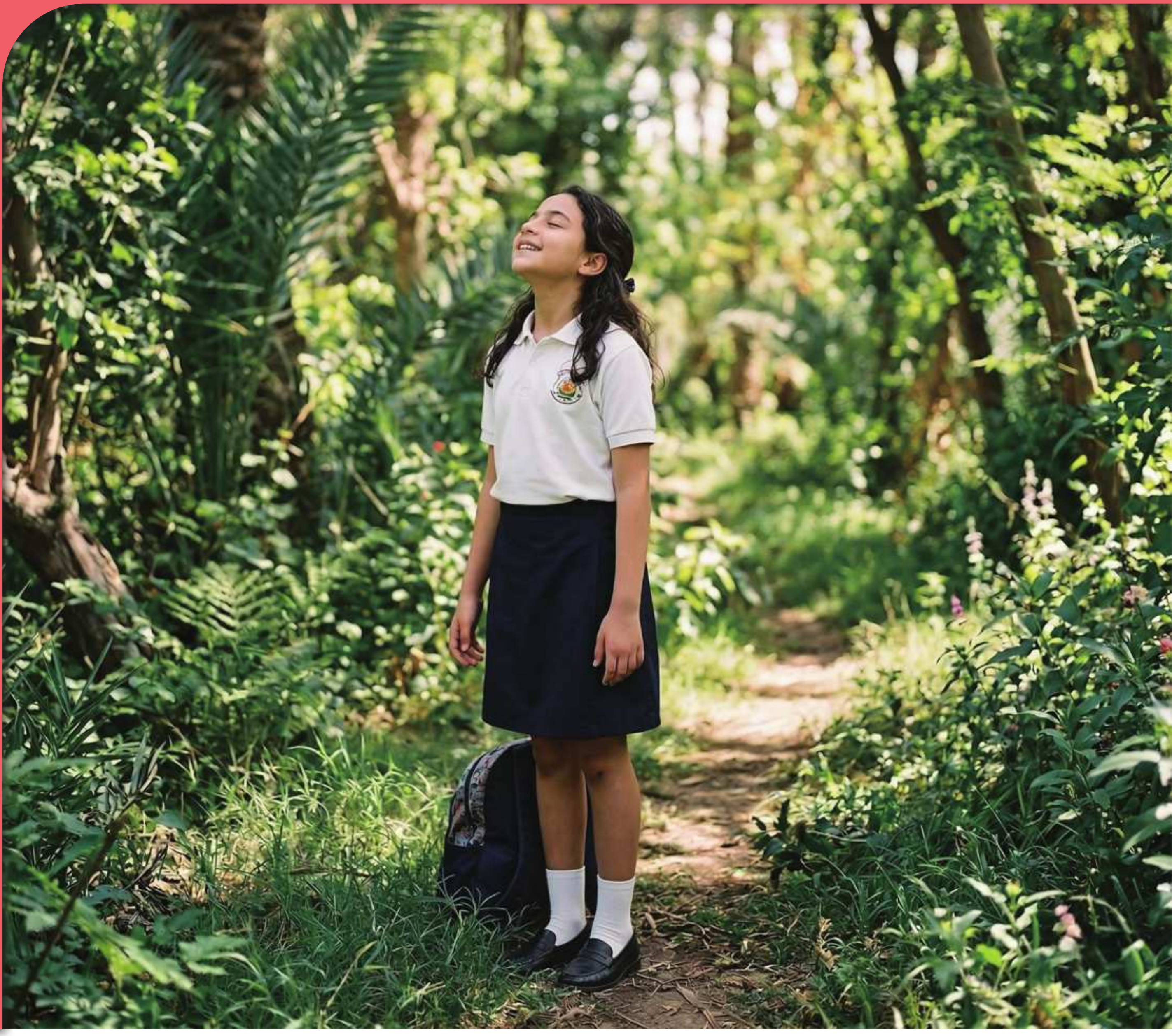
- **Benban Solar Park:**

The knowledge about combustion we learned in Chapter 1 is being used in a different way (generating electricity without burning) to protect the Earth. A giant solar power plant in Aswan brings light to Egyptian homes without producing any carbon dioxide.

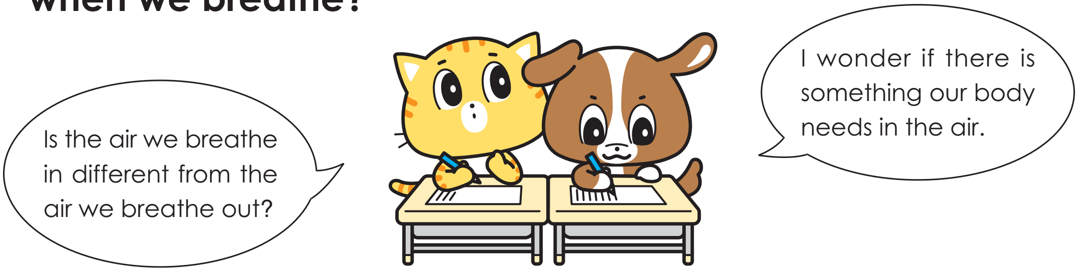

From the wisdom of mastering fire, to the wisdom of generating energy without it. The progress of science will save the future of our Earth!

2-1 How Breathing Works

Chapter 2 ····· Respiration



What do we take in from the air and what do we let out when we breathe?


Is the air we breathe in different from the air we breathe out?
I wonder if there is something our body needs in the air.

Point! Breathing and How it Works

- People breathe in and out to take in some of **the oxygen** from the air and let out **carbon dioxide**.
- Taking in oxygen and letting out carbon dioxide is called **breathing**.

Warm Up Let's check what is in the air we breathe out!

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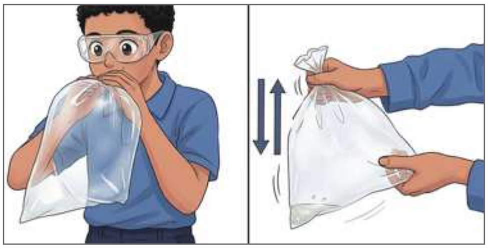
Let's do an experiment to see what is in our breath.

1 Preparation:

- Plastic bags (Polyethylene bags)
- Limewater
- Gas detector tubes (for carbon dioxide / for oxygen)
- Gas sampling pump
- Safety goggles
- Scissors

2 Test with limewater:



❶ Prepare two plastic bags.

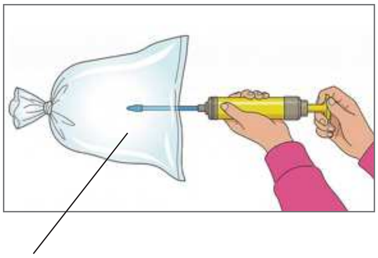
❷ Breathe into one bag, and fill the other bag with room air.

❸ Pour a little limewater into each bag and shake them well.

→ What can you learn from how the limewater changes?

3 Test with gas detector tubes:

Just like in step 2, use gas detector tubes to check the amount of oxygen and carbon dioxide in the air inside the bags.



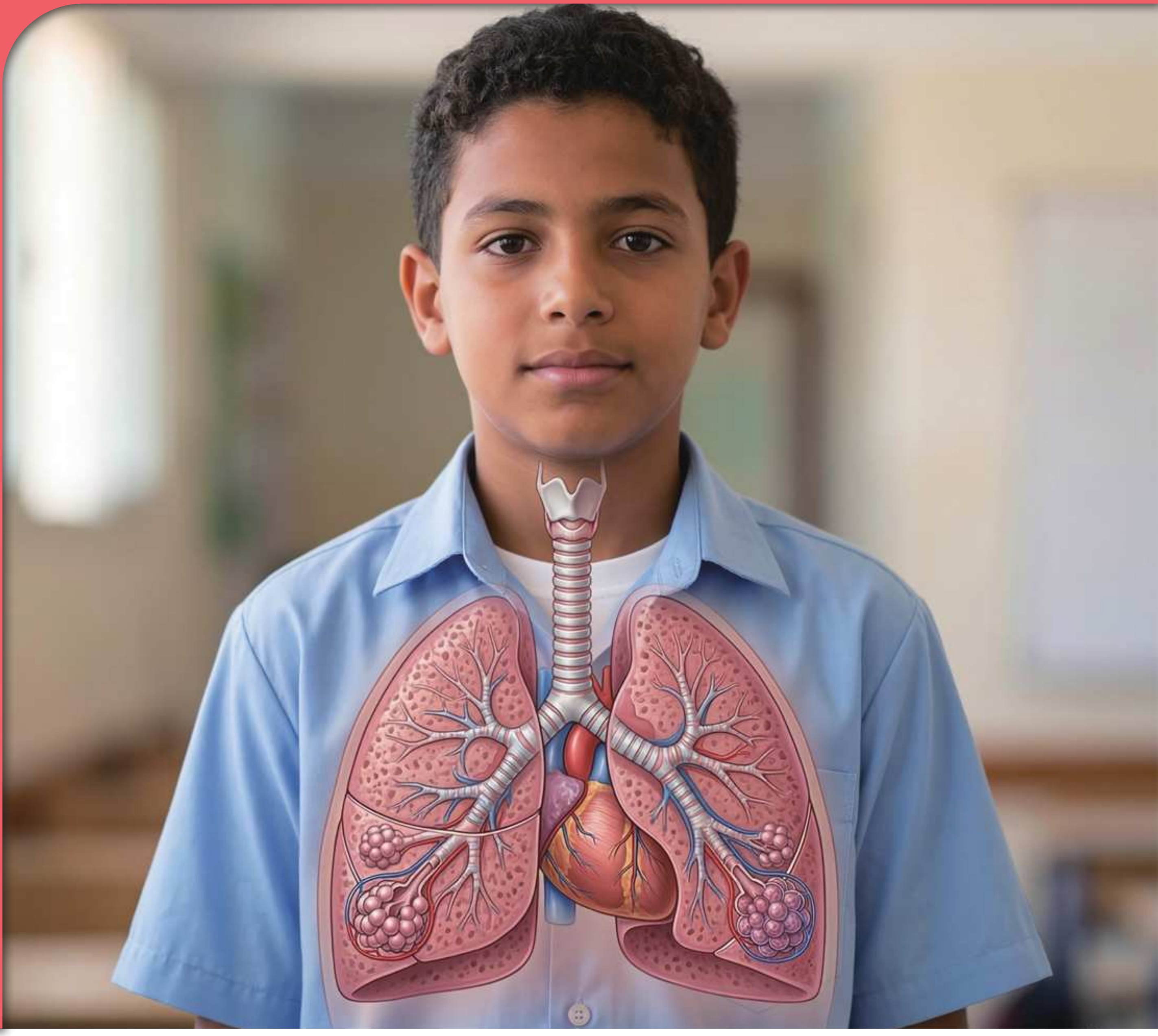
Make a small hole in the bag with scissors.

4 Compare the results:

Compare the amounts of oxygen and carbon dioxide in the air around us and the air we breathe out.

2-2 How Lungs Work

Chapter 2 ····· Respiration



Where in our body does the air we take in get exchanged?

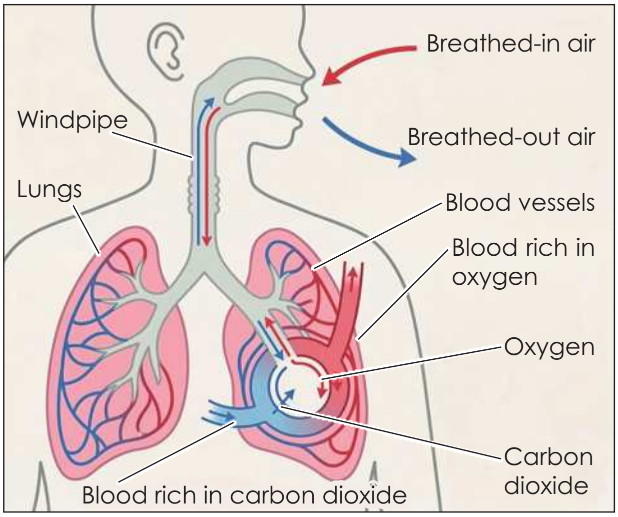
How does air move around inside our body?

Point! The Place for Gas Exchange: Lungs

The air breathed in from the nose and mouth goes through the windpipe and is sent to the left and right **lungs** in our chest.

Gas exchange

- Through the **blood vessels** around the lungs, **oxygen** in the air is taken into the blood, and **carbon dioxide** in the blood is let out into the air.
- The oxygen taken into the blood is carried to the **whole body** by the work of the heart.
- Air with a lot of carbon dioxide goes through the windpipe and is breathed out from the nose and mouth.


Breathed-in air
Windpipe
Breathed-out air
Lungs
Blood vessels
Blood rich in oxygen
Oxygen
Carbon dioxide
Blood rich in carbon dioxide

Warm Up Let's understand how the lungs move!

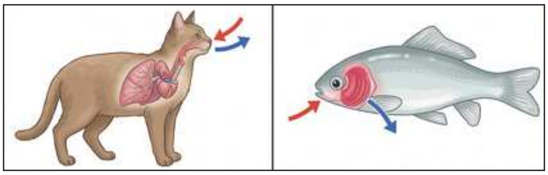
Let's use a model to think about how the lungs take air in and let it out.

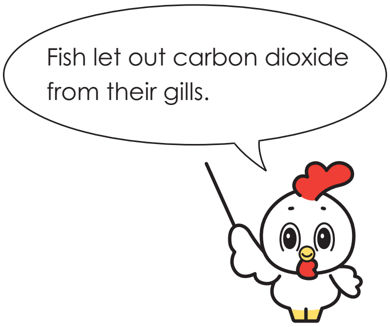
1 Check where the lungs are:
Put your hand on your chest and see how your chest moves when you breathe in.

2 Look at the model picture:

- Look at the zoomed-in picture of the alveoli and see where oxygen and carbon dioxide are exchanged.
- Imagine how the oxygen taken in by the lungs travels through the blood and is carried to your fingertips and toes.

3 Learn about other animals:
Let's learn about how other animals breathe.




Fish let out carbon dioxide from their gills.

Try

1 (1) What gas do we take into our body when we breathe in?

(2) When comparing the air we breathe in and the air we breathe out, which gas increases in the air we breathe out? Choose the correct answer from below.

A: Oxygen
B: Carbon dioxide
C: Neither increases

2 (1) What is the organ in our chest called that exchanges oxygen and carbon dioxide?

(2) Fill in the blanks with the correct words to complete the sentence.

Through the (①) around the lungs, (②) in the air is taken into the blood, and (③) in the blood is let out into the air.

Exercise

1 (1) What happens to limewater when you blow breathed-out air into it? Choose the correct answer from below.

A: It turns milky white.

B: It turns blue.

C: It disappears.

(2) Which statements correctly explain breathing? Choose all correct answers from below.

A: The air we breathe out has no oxygen at all.

B: The air we breathe out also has oxygen.

C: The air we breathe out has more oxygen than the air we breathe in.

D: The air we breathe out has more carbon dioxide than the air we breathe in.

2 (1) Which statement correctly explains gas exchange in the lungs? Choose the correct answer from below.

A: It lets out oxygen from the blood into the air.

B: It takes in oxygen from the air into the blood.

C: It takes in carbon dioxide from the air into the blood.

(2) What carries the oxygen taken in by the lungs to the whole body? Choose the correct answer from below.

A: Blood

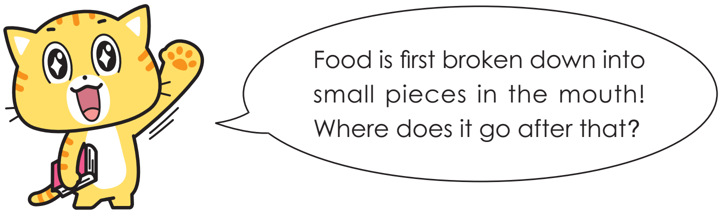
B: Muscles

C: Bones

3-1 Where Food Goes

Chapter 3 ····· Digestion

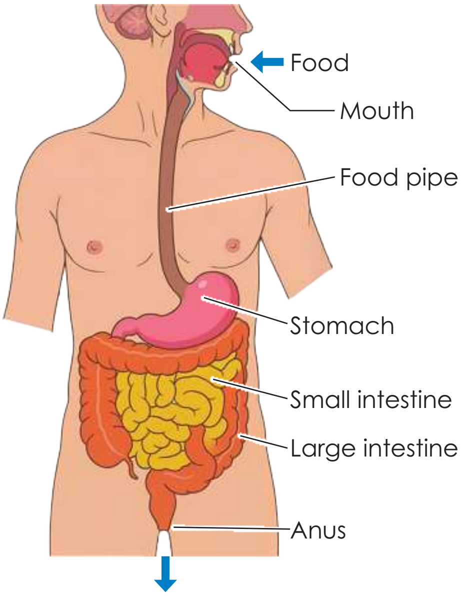
What happens to the food we eat from our mouth, where does it pass through, and how does it change its shape?


Food is first broken down into small pieces in the mouth! Where does it go after that?

Point! Digestion and How it Works

Breaking down food with teeth and changing it into a form that is easy to absorb is called **digestion**.

Food that enters from the mouth is carried in the order of **Mouth** → **Food pipe** → **Stomach** → **Small intestine** → **Large intestine**, and comes out from the anus. The path of food from the mouth to the anus is called the **digestive tract**.

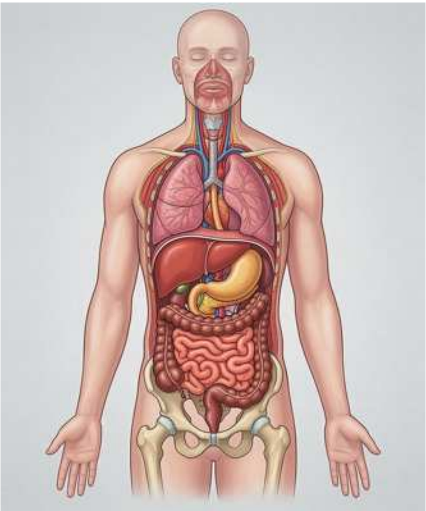


Warm Up Let's trace the route of digestion!

Imagine the "journey of food" inside your own body.

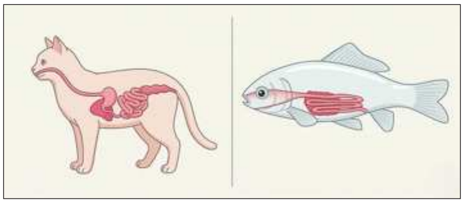
1. **Check the route:**
Write down the names of the organs the food passes through in order, from the mouth to the anus.

2. **Position of internal organs:**
Check the positions of the stomach and intestines using a picture book or an anatomical model.



3. **Check with your own body:**
Press your hands on your body to see where your stomach and intestines are located.

4. **Discovery:**
Let's find out what the digestive tracts of other animals look like.



3-2 The function of saliva

What kind of function does the saliva in the mouth have?

When you chew rice or bread, it starts to taste sweet! I wonder if it has something to do with the function of saliva.

Point! The Function of Saliva

- Saliva in the mouth has the function of breaking down **starch** contained in food. Starch contained in food is changed into something else by saliva.
- A liquid that has the function of digesting food, like saliva, is called a **digestive juice**. Digestive juices are produced not only in the mouth, but also in the stomach and intestines.

Warm Up Let's see if saliva changes starch!

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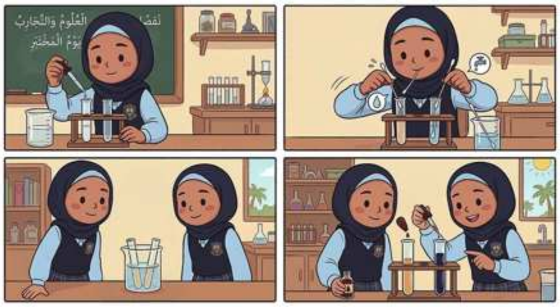
Follow the steps of the experiment and predict the results.

1 Preparation:

- Dilute starch solution (cooked rice, etc. can also be used)
- Dilute iodine solution
- Test tubes
- Beaker
- Cotton swabs
- Dropper
- Water
- Hot water
- Safety goggles

2 Experiment:



❶ Put the dilute starch solution into two test tubes with a dropper.

❷ Put a cotton swab soaked with saliva into one test tube. Put a cotton swab soaked with water into the other test tube.

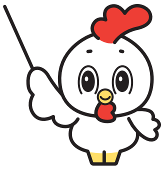
❸ Put hot water of about 40 degrees Celsius in a beaker, and put the two test tubes in it for a few minutes.

❹ Add 1 or 2 drops of dilute iodine solution to the warmed test tubes and compare the color changes.

3 Summary:

From the results of the experiment, confirm that the starch is broken down due to the function of saliva.

The reason we put them in hot water of about 40 degrees Celsius is to make **the same environment as inside the body**.



Try

1 (1) What do we call the process of changing food into a form that is easy to absorb into the body?

(2) Choose the correct words from below to fill in the blanks.

Food that enters from the mouth is carried in the order of Mouth → (①) → (②) → (③) → (④) , and comes out from the anus.

Large intestine / Stomach / Food pipe / Lungs / Small intestine

2 (1) What do we call a liquid contained in the body, like saliva, that breaks down food?

(2) Which statements correctly explain the results of the saliva experiment? Choose all correct answers.

A: The one mixed with water and starch changed to blue-black with the iodine solution.

B: The one mixed with water and starch had no change even when the iodine solution was dropped.

C: The one mixed with saliva and starch changed to blue-black with the iodine solution.

D: The one mixed with saliva and starch had no change even when the iodine solution was dropped.

Exercise

1 (1) What is the correct order that food passes through? Choose the correct answer from below.

A: Mouth → Stomach → Food pipe → Small intestine → Large intestine

B: Mouth → Food pipe → Stomach → Large intestine → Small intestine

C: Mouth → Food pipe → Stomach → Small intestine → Large intestine

D: Mouth → Food pipe → Large intestine → Small intestine → Stomach

(2) What is the path of food from the mouth to the anus called?

2 (1) In the experiment to check the function of saliva, why do you warm the test tubes in hot water of about 40 degrees Celsius? Choose the correct answer from below.

A: To disinfect.

B: To evaporate the water.

C: To make it about the same temperature as inside the body.

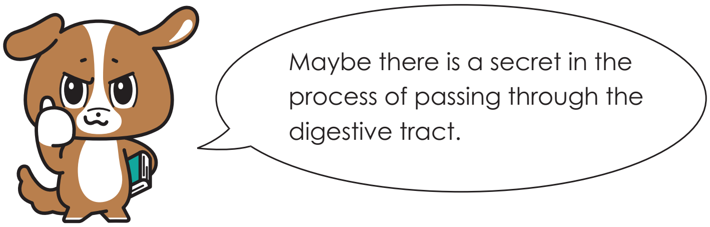
(2) After mixing saliva and starch and warming it, did the color change when you added the iodine solution? Choose the correct answer from below.

It turned blue-black. / It did not change.

3-3 How absorption works

Chapter 3 ····· Digestion

Where and how are the nutrients from the food that enters the mouth taken into the body?


Maybe there is a secret in the process of passing through the digestive tract.

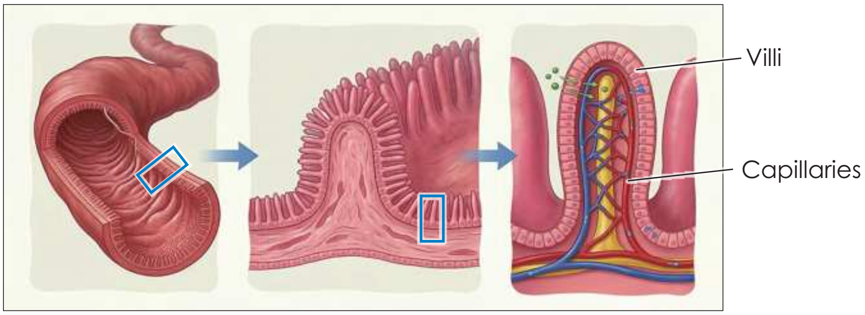
Point! The Structure of the Small Intestine and Absorption of Nutrients

The nutrients from digested food are mainly **absorbed** in the **small intestine** along with water. After that, more water is absorbed in the large intestine, and what is left is eliminated from the anus as feces.

Structure of the small intestine

- **Villi**:

  Small bumps on the inside of the small intestine. Because villi are lined up closely, the inner **surface** area of the small intestine becomes larger, and it can absorb nutrients and water efficiently.



The nutrients absorbed in the small intestine are carried to the whole body by the **blood**, passing through the **liver**. The liver works to store some of the nutrients and send them out to the whole body when needed.

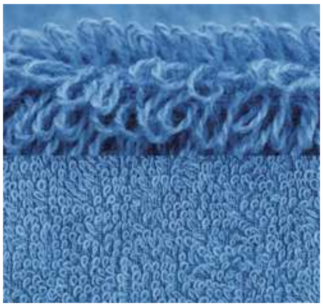
Warm Up Let's imagine the surface area of the small intestine!

Let's think about why having villi is advantageous for absorption.

1 Surface of a towel:

Look at the surface of a towel.
Remember that a cloth with many loop-like threads absorbs water better than a flat cloth.

▼Surface of a towel



2 Wall of the small intestine:

Just like a towel, the wall of the small intestine has bumps, which increases the places to absorb nutrients.

3 Look at the model:

Look at the picture and see how nutrients enter the blood vessels from the surface of the villi.

Try

(1) What do we call the small bumps on the inner wall of the small intestine that absorb nutrients?

(2) What carries the absorbed nutrients to the body? Choose the correct answer from below.

A: Blood vessels
B: Nerves
C: Muscles

(3) Where do the nutrients absorbed in the small intestine pass through first to be carried to the whole body? Choose the correct answer from below.

A: Stomach
B: Large intestine
C: Liver

Exercise

(1) What is the advantage of having villi on the wall of the small intestine? Choose the correct answer from below.

A: It makes it easier to swallow food.
B: The surface area of the wall of the small intestine becomes larger, and nutrients can be absorbed efficiently.
C: It makes it easier for nutrients to pass through.

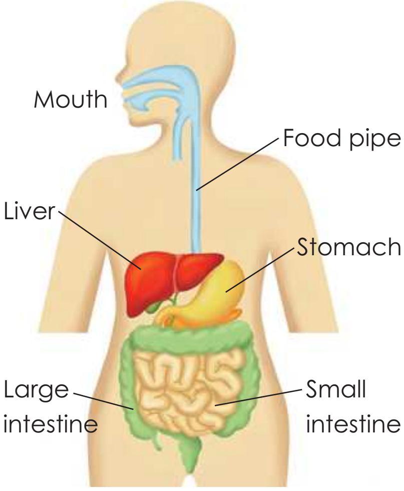
(2) Fill in the blanks with the correct words.

The nutrients of digested food, along with water, are mainly absorbed in the (①). The nutrients absorbed in the small intestine are carried by the (②) through the (③) to the whole body.

Let's Expand!

Let's take a closer look at the liver.

Functions of the Liver



- It converts some nutrients into a form that is easy for the body to use, stores them as energy, and sends them out to the whole body when needed.
- It breaks down harmful substances produced in the body so they can be eliminated in urine.
- It produces a digestive juice that helps break down and absorb fat.

Review & Practice

Let's solve the summary questions about digestion.

(1) What do we call the process of breaking down food into small pieces so that it is easy to take into the body?

(2) Which is the correct order of the digestive tract that food passes through after entering the mouth? Choose the correct answer from below.

A: Mouth → Food pipe → Small intestine → Stomach → Large intestine

B: Mouth → Stomach → Food pipe → Small intestine → Large intestine

C: Mouth → Food pipe → Stomach → Small intestine → Large intestine

(3) In the experiment to check the function of saliva, when you mix saliva with starch solution, warm it, and then add iodine solution, does the color change?

(4) Where are the digested nutrients mainly absorbed into the blood? Choose the correct answer from below.

A: Food pipe **B:** Stomach **C:** Large intestine **D:** Small intestine

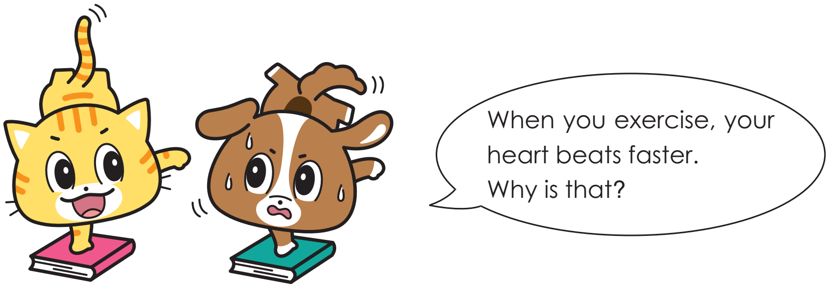
(5) What do we call the small bumps on the inner wall of the small intestine for absorbing nutrients?

(6) What do we call a liquid that has the function of breaking down food, like saliva?

4-1 Heart and Blood

Chapter 4 ····· Circulation and Excretion

What role does the heart play, and what does the blood carry throughout the body?


When you exercise, your heart beats faster. Why is that?

Point! Blood Circulation and How the Heart Works

Nutrients absorbed from the small intestine and oxygen taken in by the lungs are carried to the whole body by the **blood**. The blood is pumped out by the **heart**, travels throughout the body, and returns to the heart again.

The movement of the heart pumping out blood is called a **heartbeat**.

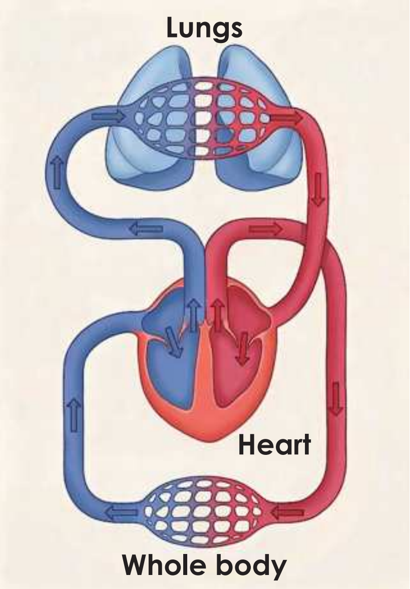
The heartbeat travels through the blood vessels and can be felt as a **pulse** at the wrist.

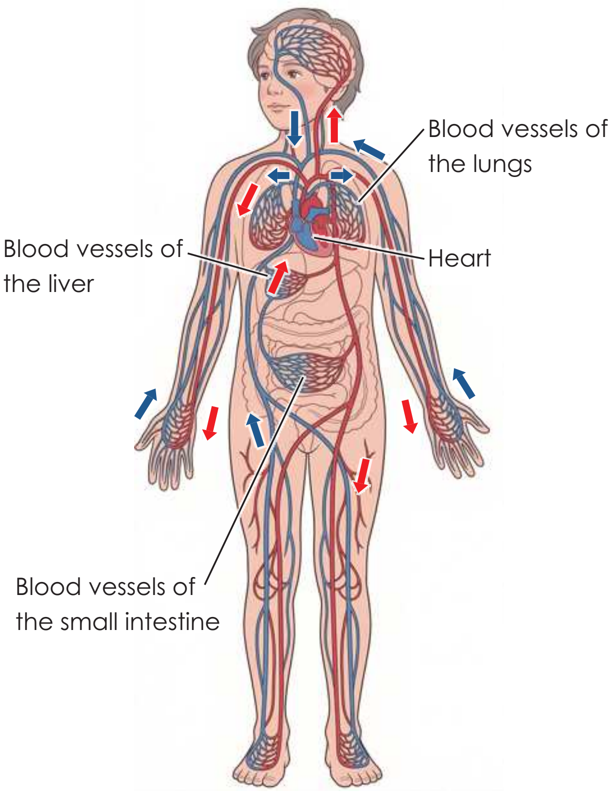
Blood Circulation

- Blood flows through blood vessels that spread all over the body, and circulates inside the body.
- The blood pumped out from the heart carries **oxygen** and nutrients to the whole body, collects **carbon dioxide** and waste produced in the body, and returns to the **heart** again.
- The blood that has returned to the heart is sent to the **lungs** to let out **carbon dioxide** and take in **oxygen**.

← **Red:**
Blood rich in oxygen

← **Blue:**
Blood rich in carbon dioxide


Lungs
Heart
Whole body


Blood vessels of the lungs
Blood vessels of the liver
Heart
Blood vessels of the small intestine

Warm Up Let's measure your pulse!

Let's check how our pulse changes when we exercise.

1 Preparation:

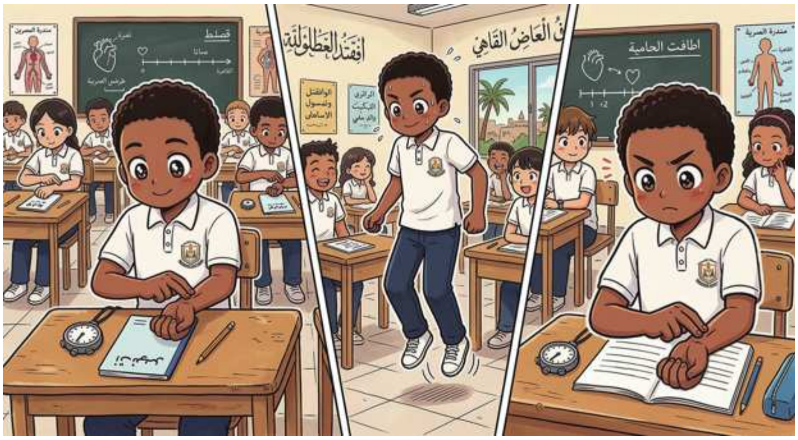
- Stopwatch

2 Experiment:

❶ Put your finger near the base of your thumb on your wrist and find the place where it is beating (throbbing).

❷ While sitting, count how many times your pulse beats in 1 minute.

❸ After jumping lightly, measure it again.



3 Compare:

Check that the heart beats faster when you exercise, and let's discuss the reason together.

You can also feel your pulse by touching your neck or ankle.

Try

(1) What is the organ that works like a pump to send blood to the whole body?

(2) What are the important things that blood carries to the whole body? Choose all correct answers from below.

A: Oxygen

B: Carbon dioxide

C: Nutrients

D: Muscles

(3) Why does your pulse become faster after exercising? Choose the correct answer from below.

A: To let the blood rest slowly.

B: To carry more oxygen and nutrients to the whole body quickly.

C: Because there are not enough nutrients.

Exercise

(1) Which statement correctly explains the heart? Choose the correct answer from below.

A: The heart plays a role in digesting the food we eat.

B: The heart is constantly beating to pump out blood.

C: The heart plays a role in storing nutrients.

(2) What do we call the movement of the heart pumping out blood?

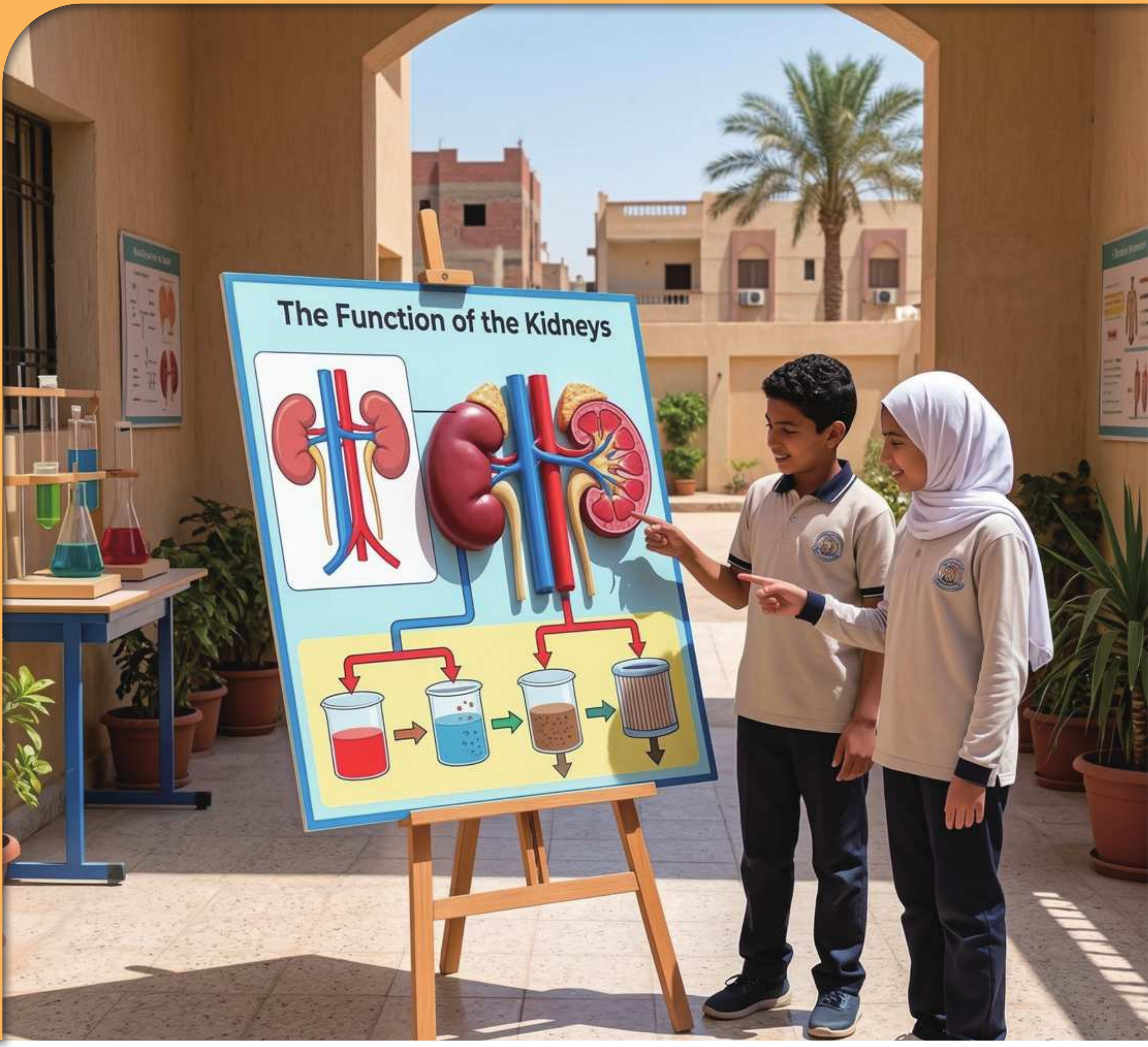
(3) Fill in the blanks with the correct words.

The blood pumped out from the heart carries (①) and nutrients to the whole body, collects (②) and waste produced in the body, and returns to the heart again. The blood that has returned to the heart is sent to the (③) to exchange (①) and (②).

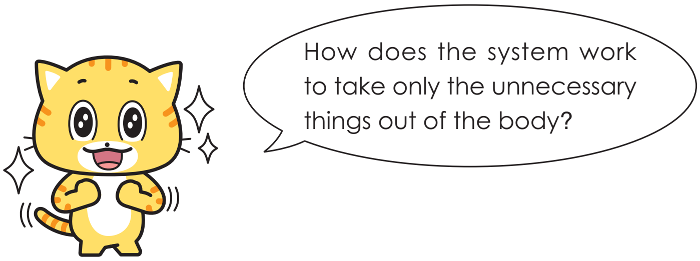
4-2

How the Kidneys Work

Chapter 4 ····· Circulation and Excretion


The Function of the Kidneys

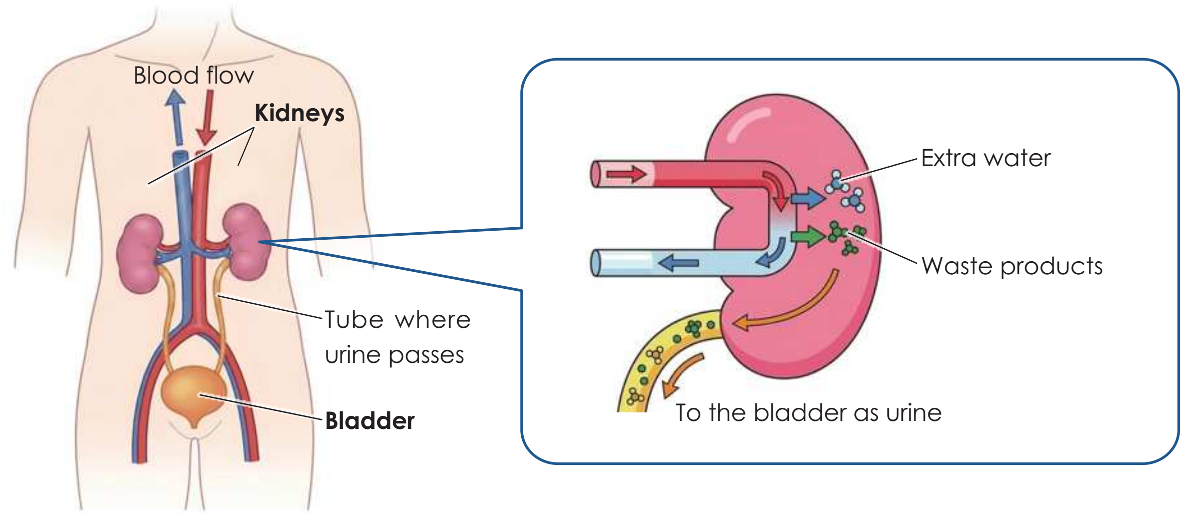
How are the “unnecessary things” collected from the whole body taken out of the body?


How does the system work to take only the unnecessary things out of the body?

Point! Discharging Waste Products

Waste products (unnecessary things produced in the body) are carried to the **kidneys** by the blood. There are **two** kidneys on the lower back.

In the kidneys, waste products produced in the body and extra water are filtered out from the blood to become **urine**. The urine produced by the work of the kidneys is temporarily stored in the **bladder**, and then discharged out of the body.


Blood flow
Kidneys
Tube where urine passes
Bladder
Extra water
Waste products
To the bladder as urine

Warm Up Let's trace the body's cleaning route!

Look at the diagram and check the order of how the waste products in the body are eliminated.

1 **Filter out:**

Imagine how the blood enters the kidneys and is filtered there.

2 **Store:**

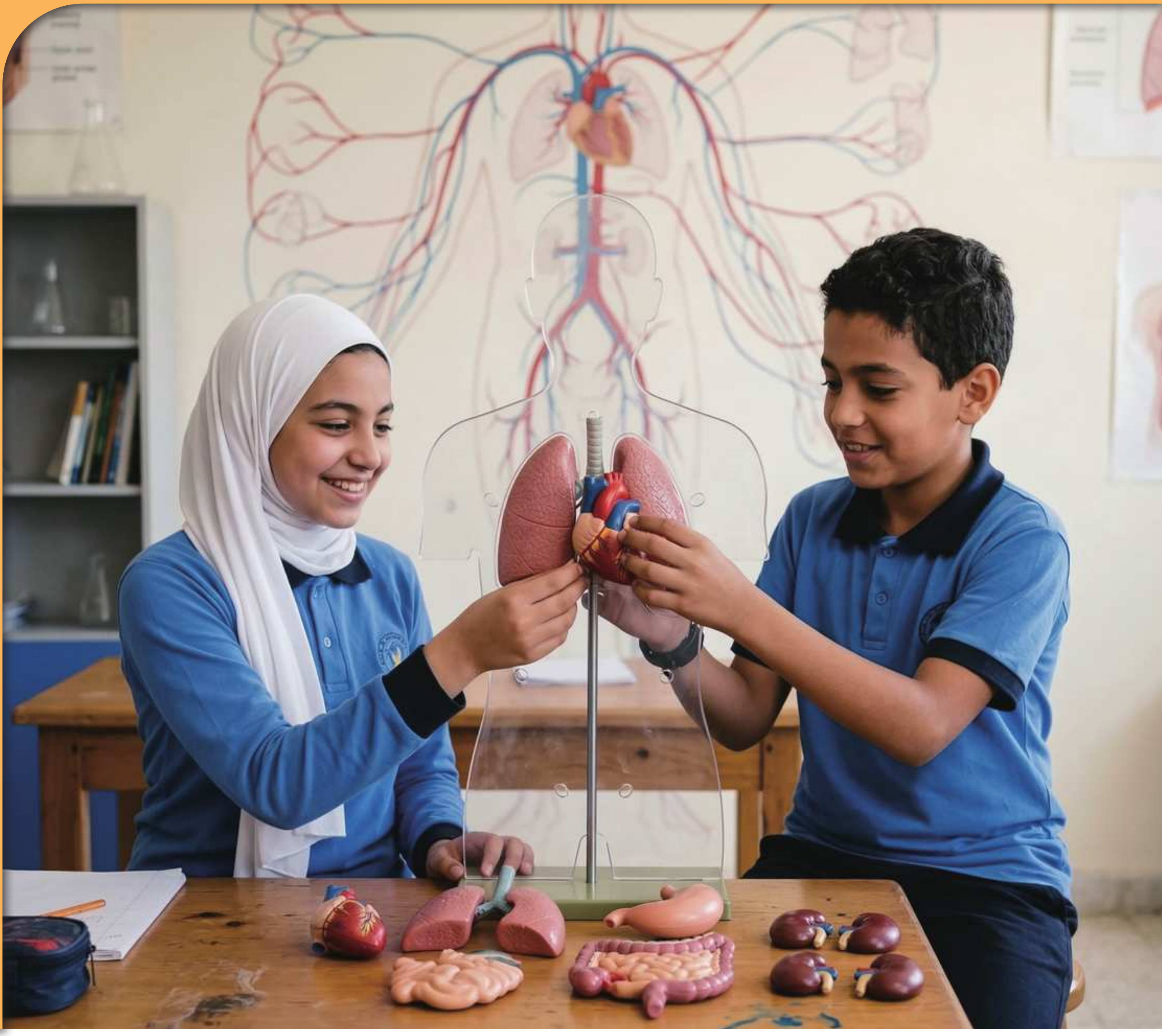
Check the place where urine (the liquid containing waste products) is temporarily stored in the bladder.

3 **Out of the body:**

Let's learn that the inside of the body is kept clean by discharging urine.

4-3 Various Organs

Chapter 4 ····· Circulation and Excretion



Where are the organs we have learned so far located in the body, and how are they connected?

We have learned about various organs so far. Let's review them together.

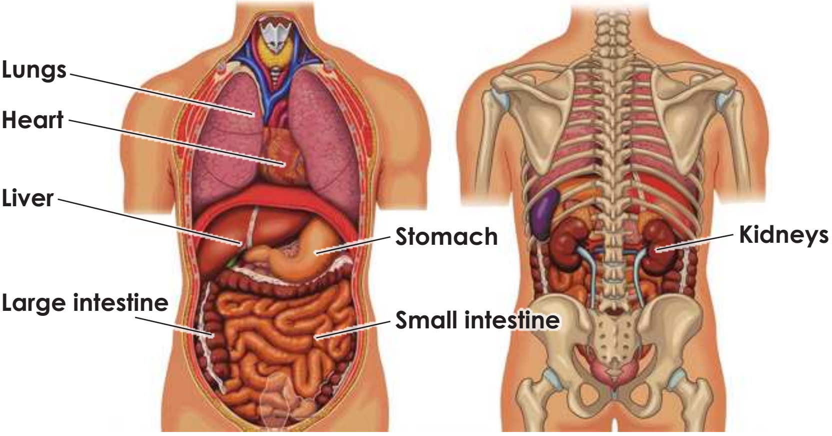
Point! Arrangement and Teamwork of Organs

- In our body, many organs are lined up closely without gaps, and they work together each other.
- Organs in the chest: There are left and right **lungs**, and the **heart** sandwiched between them. They are protected by the ribs.
- Organs in the abdomen:

  There is the **stomach** at the top, the long **small intestine** below it, and the **large intestine** around it.
- Organs in the lower back on the back side:

  There is one **kidney** on each side.
- All organs are connected by **blood vessels**, and the whole body moves by the blood carrying nutrients and oxygen and collecting waste products.

▼Front of the body ▼Back of the body



Warm Up Let's check the locations of the organs!

While looking at the illustration above, let's check the places from the top of your body.

1 **In order from the top:**
Let's check the positions of organs such as the lungs, heart, and stomach.

2 **Think about the overlapping:**
The heart and lungs are located higher than the stomach. Let's check that they are protected by the ribs.

Try

1 (1) What is the organ called that filters the blood and filters out waste products?

(2) What is the liquid waste produced in (1) called?

(3) How many of (1) are there in the body?

2 (1) Choose 2 organs that are inside the chest of the human body.

A: Stomach

B: Heart

C: Lungs

D: Large intestine

E: Small intestine

(2) Among the following organs, which one has one on each side of the body, for a total of two? Choose the correct answer from below.

A: Lungs

B: Stomach

C: Heart

D: Small intestine

Exercise

1 (1) Which statement correctly explains how the kidneys work? Choose the correct answer from below.

A: It absorbs oxygen from the blood.

B: It pumps blood to the whole body.

C: It takes out waste products from the blood.

(2) Where is the urine produced in the kidneys temporarily stored until it is discharged out of the body?

2 (1) Which statement correctly describes where the organs are located? Choose the correct answer from below.

A: The small intestine is outside the large intestine and surrounds the large intestine.

B: The stomach is connected to the food pipe.

C: The stomach is on the lower side of the abdomen.

D: There are two kidneys on the abdomen side.

(2) Fill in the blank with the correct word.

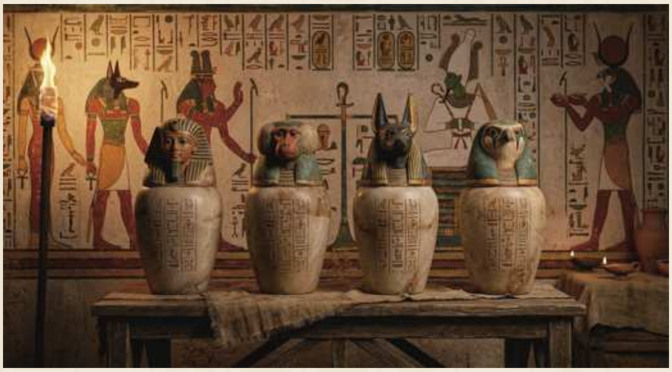
Each organ is not moving separately, but all are connected by ( ) and work together.

Chapter 4 Column:
The Mystery of the Human Body-Ancient Wisdom and Modern Science

1 What Mummies Taught Us About the Locations of Our Organs

In Chapters 2 through 4, we learned how the lungs, stomach, heart, and kidneys work. In fact, ancient Egyptians were the first people in the world to know the exact locations and shapes of these organs, thanks to their mummy-making skills.

- **The Secret of Canopic Jars:**
  When ancient Egyptians made mummies, they kept four very important organs — the lungs, stomach, liver, and intestines — safe in special jars. They knew that these were important "engines" that supported human life.
- **The Heart is the "Place of Wisdom":**
  As we learned in Chapter 4, the heart is a pump that sends blood throughout the body. However, ancient people believed the heart was where the "mind" (or soul) resided, so they left it inside the body.

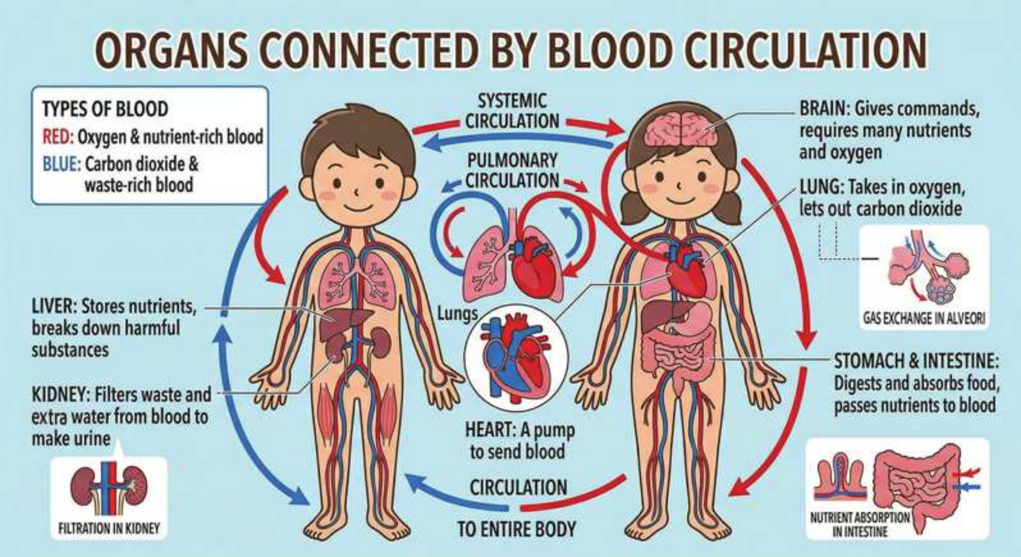


Canopic Jars

- Imsety: Has a human shape and was believed to be the god who protects the **liver**.
- Hapi: Has a baboon shape and was believed to be the god who protects the **lungs**.
- Duamutef: Has a jackal (wild dog) shape and was believed to be the god who protects the **stomach**.
- Qebehsenuef: Has a falcon shape and was believed to be the god who protects the **intestines**.

2 Keeping Our Body's Organs Healthy

In modern science, we learn that our organs do not work separately. They are all connected together by the circulation of blood.


ORGANS CONNECTED BY BLOOD CIRCULATION
TYPES OF BLOOD
RED: Oxygen & nutrient-rich blood
BLUE: Carbon dioxide & waste-rich blood
SYSTEMIC CIRCULATION
PULMONARY CIRCULATION
BRAIN: Gives commands, requires many nutrients and oxygen
LUNG: Takes in oxygen, lets out carbon dioxide
GAS EXCHANGE IN ALVEORI
LIVER: Stores nutrients, breaks down harmful substances
Lungs
KIDNEY: Filters waste and extra water from blood to make urine
STOMACH & INTESTINE: Digests and absorbs food, passes nutrients to blood
HEART: A pump to send blood
FILTRATION IN KIDNEY
CIRCULATION
TO ENTIRE BODY
NUTRIENT ABSORPTION IN INTESTINE

- **The Transporters of Oxygen and Nutrients:**

The oxygen we breathe in through our lungs and the nutrients we absorb from our small intestine are all carried to cells all over our body by the blood, using the pumping power of the heart.

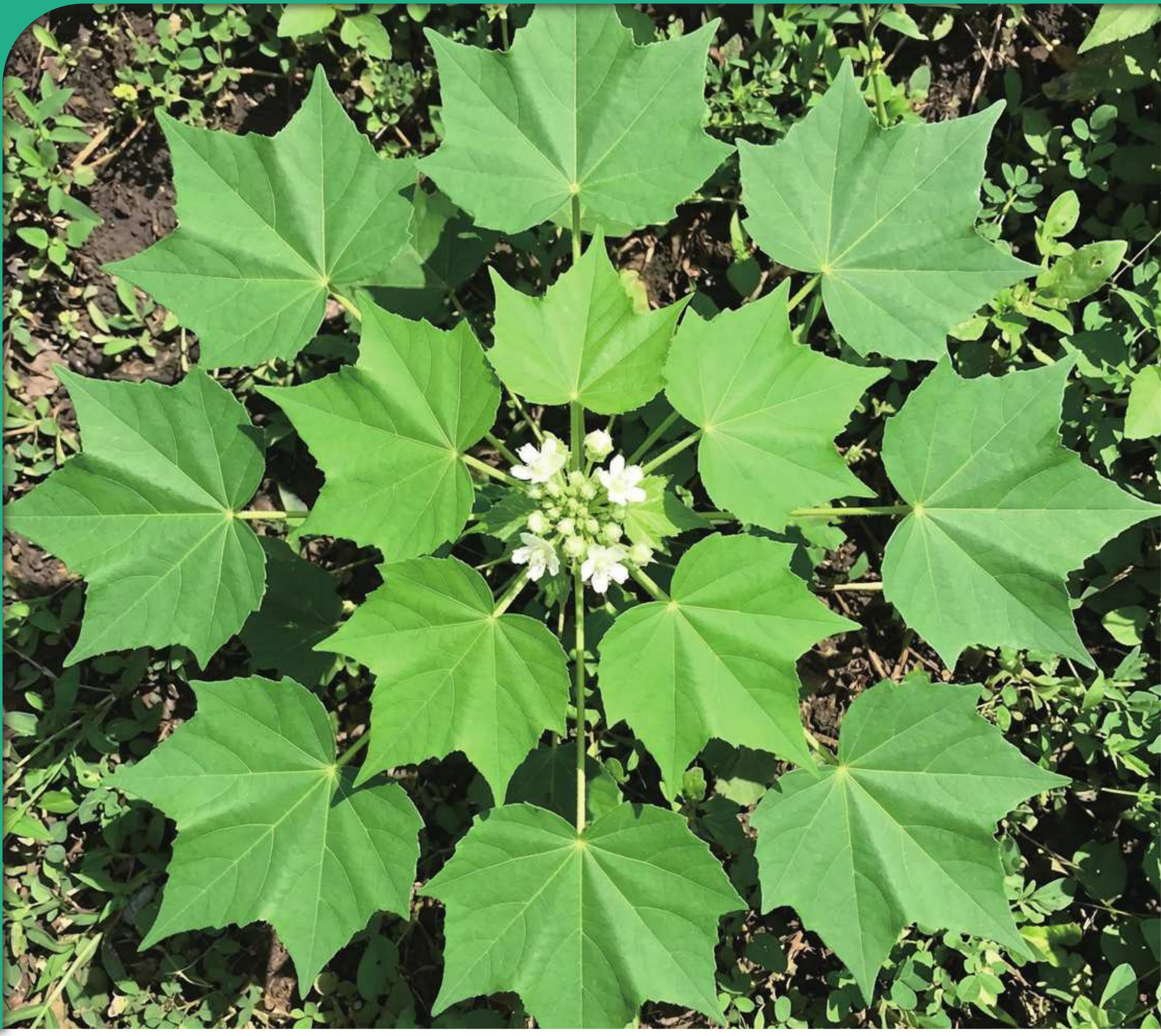
- **Egyptian Food for Good Health:**

Our bodies are made from the food we eat. A traditional Egyptian food called "Molokhia" is full of nutrients that help keep our blood flowing smoothly and help us digest our food. Learning how our body works helps us understand why taking care of our daily meals is so important.

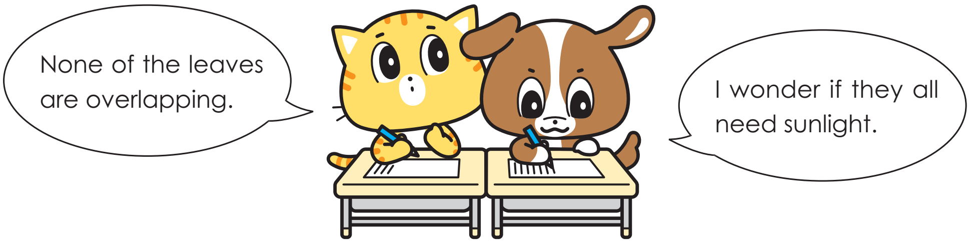
Inside our bodies, the heart works without resting to pump blood and deliver oxygen and nutrients from our food to every corner of our body!

5-1 Sunlight and Starch

Chapter 5 ····· Photosynthesis



What is made when sunlight hits the leaves of plants?


None of the leaves are overlapping.
I wonder if they all need sunlight.

Point! Plants and Nutrients

When sunlight hits the leaves of plants, the **starch** they need to grow is produced.

How to check if sunlight is needed to produce starch

- **Condition to change**: **Whether the leaf gets sunlight or not**.
- Since there might already be starch in the leaves, cover the leaves from the day before the experiment so that sunlight does not hit them.

Reaction with iodine solution

When you add **iodine solution** to starch, the color changes to **blue-black**.

How to check for starch in leaves

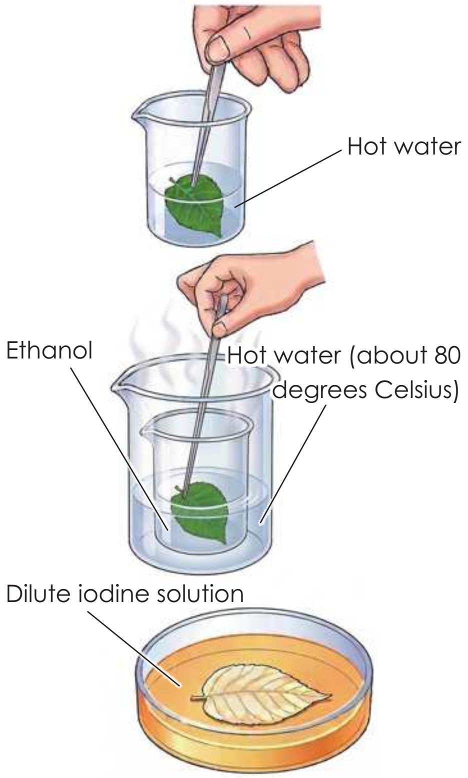
❶ Put the leaf in hot water to make it soft.

[Caution!]
- Do not touch the hot water directly, or you will get burned.

❷ Put the leaf from ❶ into ethanol warmed in hot water. (To remove the green color from the leaf)

[Caution!]
- Ethanol is highly flammable, so do not heat it directly over a flame.

❸ Wash the leaf from ❷ with hot water, and soak it in dilute iodine solution.



Warm Up Let's check how leaves produce nutrients!

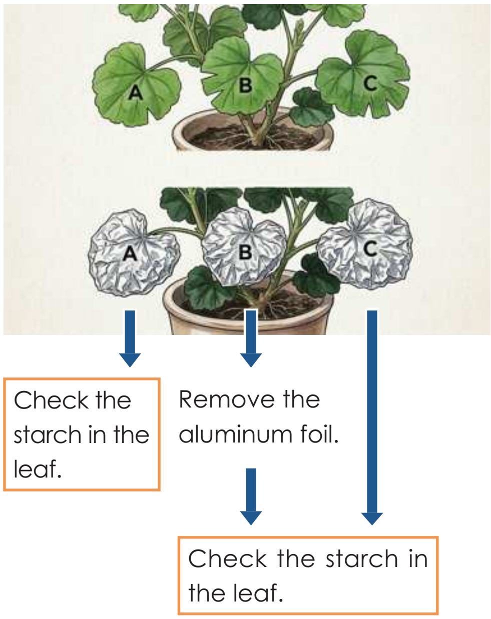
Let's check the relationship between sunlight and starch in leaves.

1 Preparation:

- Plant
- Ethanol
- Hot water (about 80 degrees Celsius)
- Aluminum foil
- Beaker
- Dilute iodine solution
- Petri dish

2 The day before the experiment:

- Make small cuts in each leaf so you can tell **A**, **B**, and **C** apart.
- Cover the plant's leaves with aluminum foil so they do not receive sunlight.

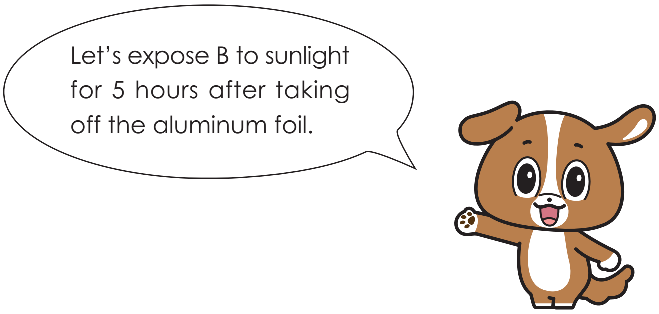

A
B
C
A
B
C
Check the starch in the leaf.
Remove the aluminum foil.
Check the starch in the leaf.

3 Morning of the experiment day:

- Remove the aluminum foil from **B**.
- Take leaf **A** and check if there is any starch.

4 5 hours later:

- Take leaves **B** and **C** and check if there is any starch.


Let's expose B to sunlight for 5 hours after taking off the aluminum foil.

Try

(1) What nutrient is produced when sunlight hits the leaves of plants?

(2) What color does a leaf that was in the sunlight turn when soaked in iodine solution? Choose the correct answer from below.

A: Does not change

B: Red

C: Blue-black

D: Yellow

(3) In the experiment to check if sunlight is needed to produce starch, what is the condition you change?

Exercise

(1) If you hide a part of a leaf with aluminum foil to block the sunlight, how will that part react to the iodine solution reaction?

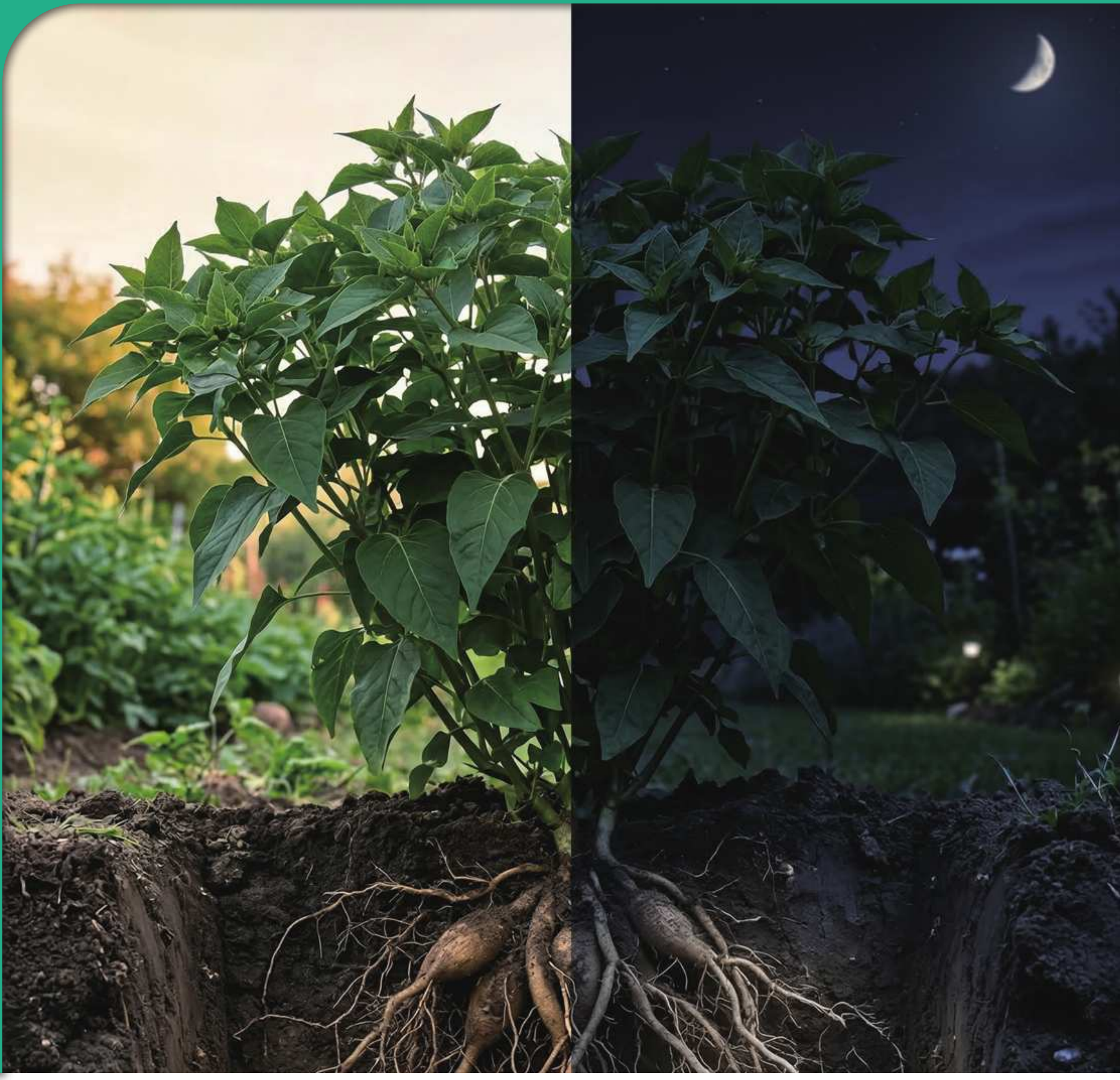
(2) Which of the following explanations is correct? Choose the correct answer from below.

A: Plants produce starch by receiving sunlight.

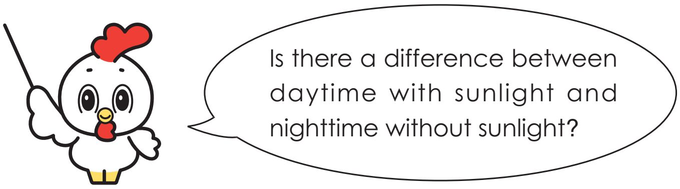
B: Plants produce starch by blocking sunlight.

5-2 Gas Exchange

Chapter 5 ····· Photosynthesis



How do plants exchange gas with the air?


Is there a difference between daytime with sunlight and nighttime without sunlight?

Point! The Relationship between Plants and Air

When sunlight is hitting the leaves, plants take in **carbon dioxide** and release **oxygen**.

Plants also breathe to live and stay active. In **breathing**, they take in **oxygen** and release **carbon dioxide**.

The relationship between day and night, and air

- Daytime: Because there is light, taking in **carbon dioxide** and releasing **oxygen** is very active.

  *Breathing is also happening, but overall, they take in more carbon dioxide.

- Nighttime: Because there is no light, they only breathe, taking in **oxygen** and releasing **carbon dioxide**.

Warm Up Let's measure the gas inside the bag!

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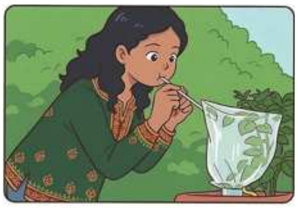
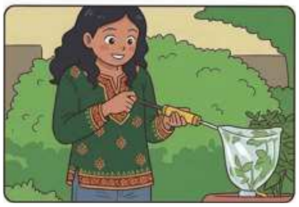
Let's predict how the air will change after a while when a plant is wrapped in a bag.

1 Preparation:

- Plant
- Polyethylene bag
- Straw
- Twist tie
- Gas detector tube for oxygen
- Gas detector tube for carbon dioxide
- Gas sampling pump
- Scissors

2 Experiment:





❶ On a sunny day, put a bag over the plant, tie the base with a twist tie, and breathe into it.

❷ Make a small hole in the bag with scissors, and use the gas detector tube to check the percentage of oxygen and carbon dioxide inside the bag.

❸ Leave it in a place with sunlight for about 1 hour.

❹ Let's use the gas detector tube to check how the percentage of carbon dioxide and oxygen has changed.

3 Summary:

- Let's summarize the percentages of carbon dioxide and oxygen we checked in ❷ and ❹. Let's talk about how the air changed.

Try

(1) What gas do plants release into the air when they are in the sunlight?

(2) What gas do plants take in from the air when they breathe? Choose the correct answer from below.

A: Oxygen
B: Carbon dioxide
C: Nitrogen

Exercise

(1) During the night, when there is no light, what kind of gas exchange do plants do? Choose the correct answer from below.

A: Take in oxygen and release carbon dioxide (breathing).

B: Take in carbon dioxide and release oxygen.

(2) Which statement correctly explains plants and air? Choose the correct answer from below.

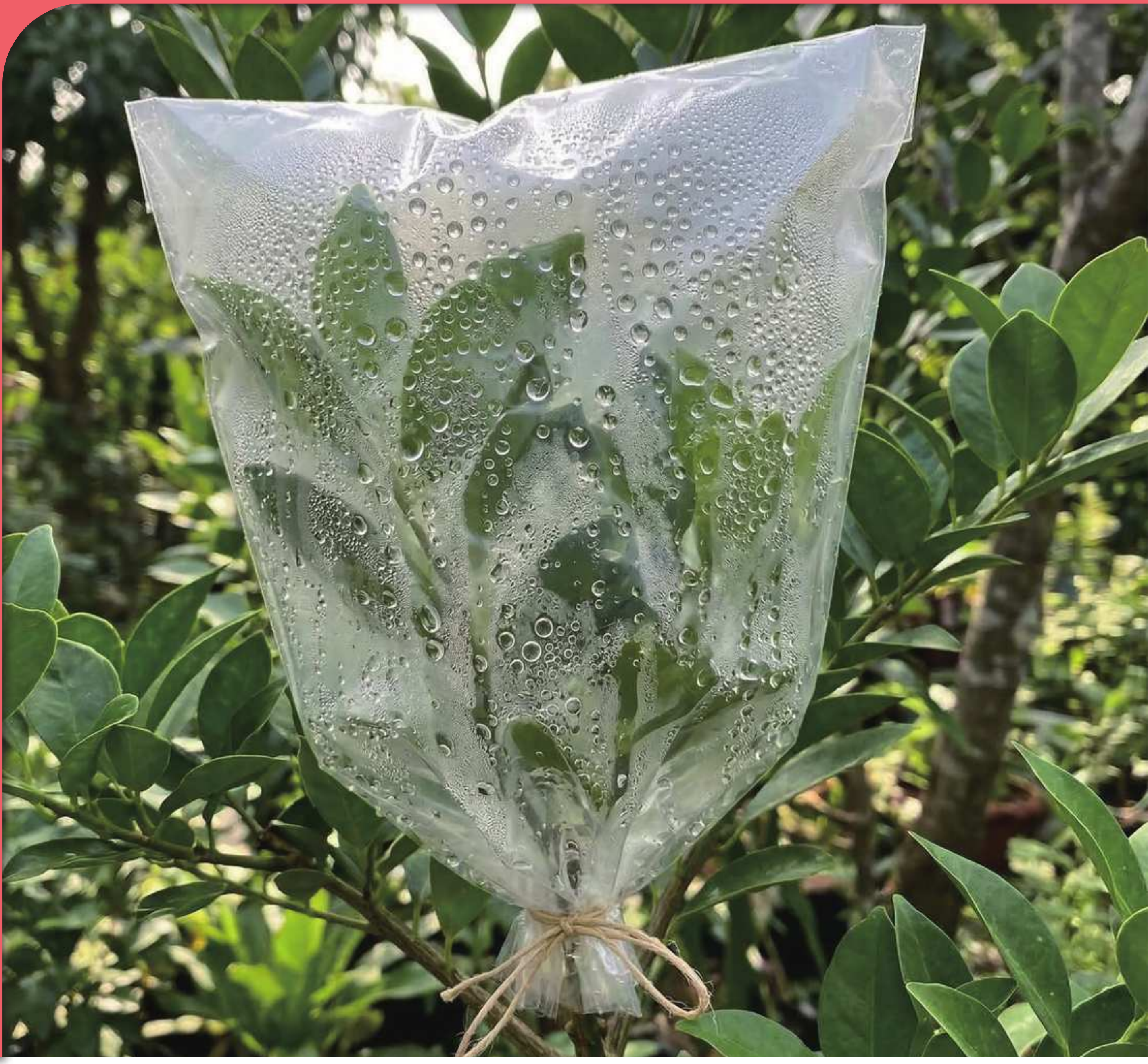
A: Plants keep releasing only oxygen all day long.

B: During the daytime, they take in more carbon dioxide than the carbon dioxide they release by breathing.

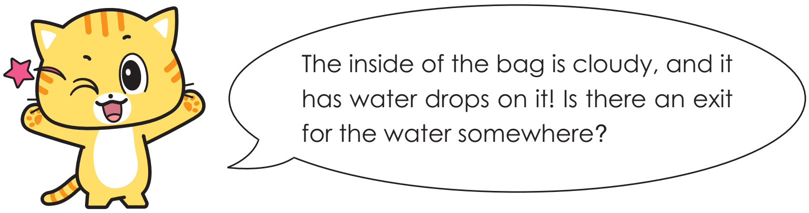
C: While the sunlight is hitting them, plants do not breathe.

6-1 Transpiration

Chapter 6 ····· Transportation of Water in Plants



Where does the water that plants absorb from their roots go?

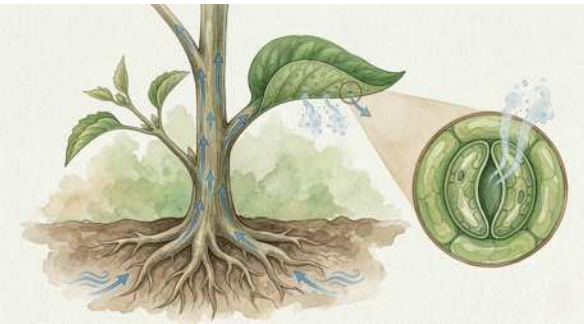

The inside of the bag is cloudy, and it has water drops on it! Is there an exit for the water somewhere?

Point! Plants and Water

Some of the water absorbed from the roots goes out into the air from the leaves. The process of water inside the plant changing into water vapor and being released into the air is called **transpiration**.

Stomata:

These are small pores mostly found on the underside of the leaves. They act as exits for water vapor. Transpiration mainly happens through the **stomata**.



46

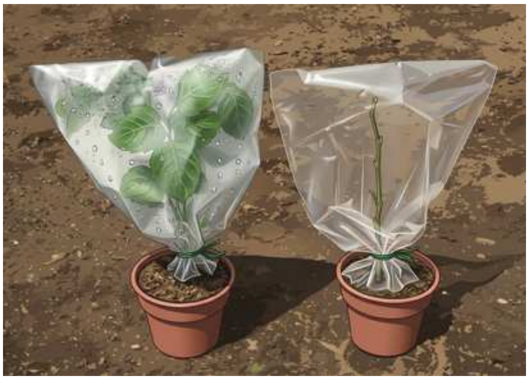
Warm Up Let's find the water drops in the bag!

Let's observe that water is coming out of the leaves.

1 Preparation:

- Plants (Plant A with leaves and Plant B with all the leaves taken off)
- Plastic bags
- Twist ties or strings (to tie the bag)

2 Experiment:



❶ On a sunny day, put bags over Plant A (with leaves) and Plant B (with all leaves taken off), and tie the bases with twist ties or strings.

❷ Leave them in a sunny place for a while.

❸ Check if water drops form inside the bags. This is the water that transpired from the leaves.

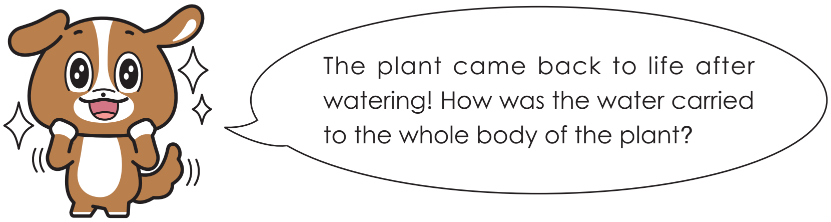
3 Compare:

- Let's check how the inside of the bags is different between A and B.
- Let's talk about what we can learn from this experiment.

6-2 The Path of Water

Chapter 6 ····· Transportation of Water in Plants

Where does the water absorbed from the roots pass through to be carried to the whole body?


The plant came back to life after watering! How was the water carried to the whole body of the plant?

Point! The Relationship between Plants and Water

If you water the base of a wilted plant, the plant recovers after a while. This is because water spreads to the whole body of the plant.

There are paths in the roots, stems, and leaves of plants to carry water.

Water is transported in the order of **Roots → Stems → Leaves**.

45

Warm Up Let's observe the path of water!

Let's use colored water to visualize where the water passes through.

1 Preparation:

- Plant
- Colored water
- Flask
- Cutter knife
- Absorbent cotton
- Magnifying glass or microscope

2 Experiment:

❶ Dig up the plant with the soil, and wash the roots with water.

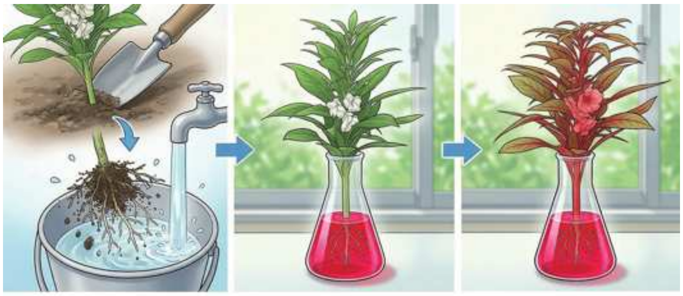
❷ Put colored water in the flask and soak the roots in it.

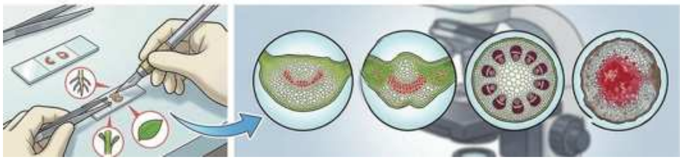
❸ After a few hours, observe the color change in the plant.

❹ Cut the roots, stems, and leaves with a cutter knife, and observe the cut surfaces.

3 Summary:

- The parts that turned red are the paths for the colored water.
- Let's sketch and summarize.





Try

1 (1) What is it called when the water inside a plant changes into water vapor and is released from the leaves?

(2) In the experiment to check that water comes out of the leaves, what is the reason why water drops formed inside the plastic bag? Choose the correct answer from below.

A: Because it rained from outside.

B: Because water vapor came out of the leaves and changed into water.

C: Because the plant breathed and released carbon dioxide.

2 (1) Write the order in which the water absorbed from the roots passes through. Fill in the blanks with the correct words.

(①) → (②) → (③)

(2) What happens after a while when you water the base of a wilted plant?

Exercise

1 (1) What are the small pores called, which are mostly on the underside of leaves, that act as exits for water vapor?

(2) Which statement correctly explains transpiration? Choose the correct answer from below.

A: Transpiration actively happens from the stems, not the leaves.

B: Transpiration is when plants release oxygen.

C: Transpiration happens through the small pores on the underside of the leaves, which act as exits for water vapor.

2 (1) Which statement correctly explains the path of water in plants? Choose the correct answer from below.

A: Water flows freely everywhere inside the stem.

B: Tubes are connected from the roots to the tips of the leaves to carry water.

C: The water absorbed from the roots passes through the stems, but does not go to the leaves.

(2) When a plant is wilted, what should you do to recover it?

Chapter 6 Column: Blessings of the Nile-Plant Survival Strategies

1 The “Green Factory” That Turns Sunlight into Electricity

In Chapters 5 and 6, we learned about photosynthesis, where plants use sunlight to produce starch.

- **Solar Panels on the Water Lotus:**

The leaves of the lotus (water lily) floating on the Nile River have a flat and large shape. This shape helps them catch as much of Egypt’s strong sunlight as possible so they can produce nutrients (starch) efficiently.

- **Exchanging Gases:**

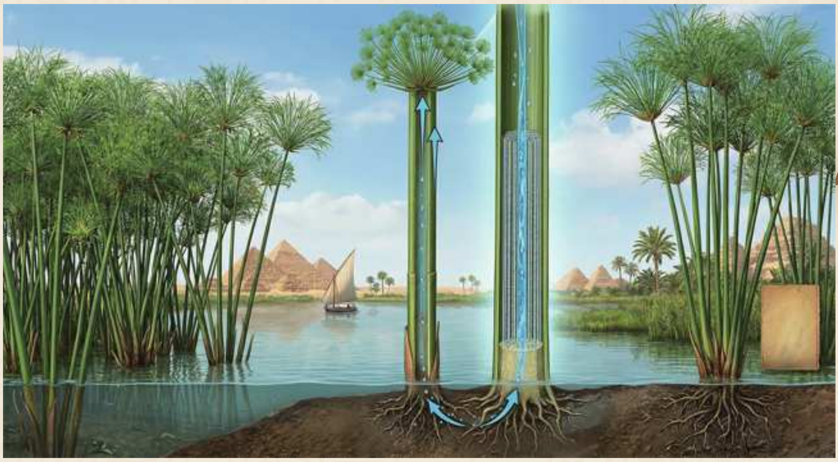
When plants do photosynthesis, they take in the carbon dioxide that humans breathe out and release oxygen. The beautiful green plants along the Nile River act as a “natural air purifier” to keep the air in Egypt clean.

2 Water Paths and the Wisdom of Papyrus

In Chapter 6, we learned how water absorbed by the roots travels up to the leaves and escapes into the air through transpiration.

- **Papyrus Straws:**

Papyrus, a plant used to make paper in ancient times, grows many meters tall near the water. Inside its stem, there are strong, straight water paths that carry the water absorbed from the roots all the way to the top at once.



- **The Science of Sprinkling Water:**

Transpiration is the process where water vapor comes out of the leaves, and it works to lower the temperature around the plant. In the desert country of Egypt, the reason it feels cool when you get close to plants is because they act like a natural sprinkler to cool the air for us.

7-1 Food Chain

Chapter 7 ····· Food Chain

How are living organisms connected by what they eat?

Humans also live by eating living organisms like plants and animals.

Point! How the Food Chain Works

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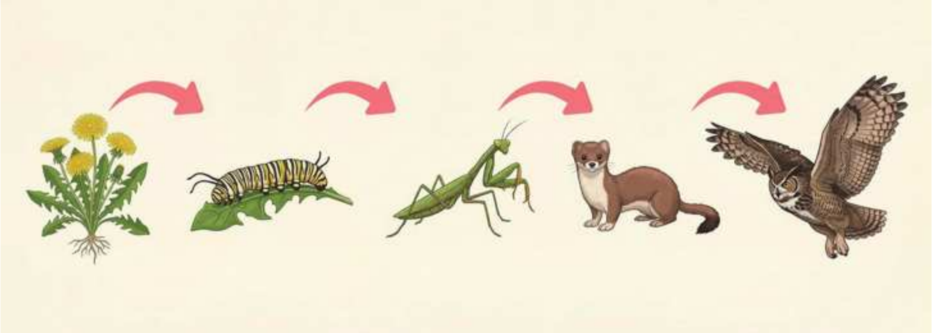
The "eat and be eaten" connection (feeding relationship) between living organisms is called a **food chain**.

① **Plants**: They use sunlight to produce nutrients inside their bodies. This is the beginning of the food chain.

② **Herbivores**: Animals that eat plants.
(Example: Grasshoppers, rabbits, etc.)

③ **Carnivores**: Animals that eat other animals.
(Example: Snakes, eagles, lions, etc.)

The connection is shown using arrows like "Grass → Grasshopper → Frog". The arrow points to the direction energy is carried.



Warm Up Let's complete the connection!

Imagine the connections between living organisms around you and connect the chain.

1 **Find the start:**

First, find a plant in your garden or a park.

2 **Find what eats it:**

What kind of bugs are eating the leaves of that plant?

3 **Think further ahead:**

Are there any birds or lizards that eat that insect?

4 **Draw arrows:**

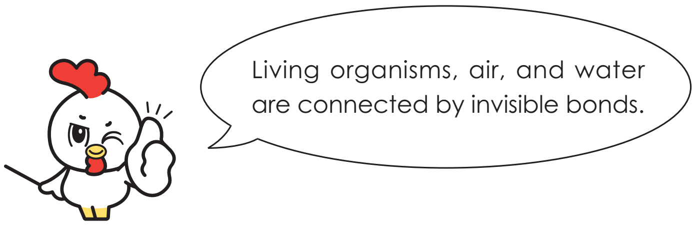
Connect the living organisms you observed with arrows, and write down one food chain in your notebook.

7-2

Living Organisms, Air, and Water

Chapter 7 ····· Food Chain

How are living organisms connected through air and water?


Living organisms, air, and water are connected by invisible bonds.

Point! Circulation of Air and Water

Connection of living organisms through air

Animals use the **oxygen** released by plants to breathe, and plants use the **carbon dioxide** breathed out by animals for photosynthesis.

Connection of living organisms through water

Plants release water into the air through **transpiration**. This water vapor joins the water cycle. Water also evaporates from oceans, rivers, and lakes, rises into the atmosphere to from clouds, and falls as rain. Transpiration is an important part of the water cycle that keeps water moving between living organisms and the environment.

Our lives are constantly supported by the oxygen produced by plants and the water circulating around the Earth!

Warm Up Let's feel grateful for water and air!

Let's follow the steps and think about how air and water move between living organisms.

1 Check the path of breathing:

Be aware of your own breathing and imagine how "the breath you just breathed out is used for photosynthesis by the tree next to you".

2 Trace the journey of water:

Let's talk about the possibility that the water you drank today was once a cloud, or water that a tree in some country absorbed.

3 Think about the balance:

Let's predict what would happen to the oxygen and carbon dioxide in the air if plants completely disappeared.

Try

1 (1) What do we call the feeding relationship between living organisms?

(2) What kind of living organisms are the beginning of the food chain? Choose the correct answer from below.

- A: Strong carnivores
- B: Herbivores like insects
- C: Plants that produce nutrients using sunlight

2 (1) What gas do animals breathe out and plants take in?

(2) What do we call the process where plants release water absorbed from their roots into the air as water vapor? Choose the correct answer from below.

- A: Evaporation
- B: Transpiration
- C: Breathing

Exercise

1 (1) Arrange the following living organisms in the correct order of the food chain and connect them with arrows.

[Grasshopper / Wheat / Eagle / Frog]

( ) → ( ) → ( ) → ( )

(2) Which statement correctly explains the food chain? Choose the correct answer from below.

A: Arrows are drawn from the one that eats to the one that is eaten.

B: If carnivores disappear, plants will grow healthier.

C: Plants use sunlight to produce nutrients inside their bodies.

2 (1) Which statement correctly explains the relationship between living organisms and air? Choose the correct answer from below.

A: Both animals and plants only decrease oxygen and increase carbon dioxide.

B: The environment where animals can breathe is maintained because plants release oxygen.

(2) About the connection of living organisms through water, choose the correct word from below to fill in the blank.

The water on Earth is changing its shape and ( ), and it is used repeatedly by many living organisms.

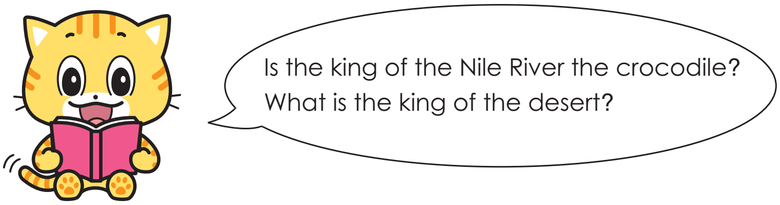
circulating / disappearing / increasing

8-1

Desert and Nile Food Chains

Chapter 8 ····· Egypt Special Part 1

How are living organisms connected in the Nile River and the desert?


Is the king of the Nile River the crocodile?
What is the king of the desert?

Point! Ecosystems in Egypt

Egypt has completely different food chains in aquatic environments (the Nile River) and arid areas (deserts).

Food Chain in the Nile River

Algae and water plants → **Herbivorous fish** (like the Nile tilapia) → **Carnivorous fish** (like the Nile perch) → **Top carnivores** (like the Nile crocodile)

Food Chain in the Desert

Desert shrubs and grass → **Herbivores** (like grasshoppers and jerboas) → **Top carnivores** (like fennec foxes and Egyptian vultures)

Even if the types of animals are different, the chain always starts with plants and ends with large carnivores.

Warm Up Let's find the king of the food chain!

Let's find the animals at the top of the food chains in the Nile River and the desert.

1 **Observe the Nile River:**

Trace the route starting from small water plants all the way up to the big crocodile.

2 **Observe the Desert:**

Trace the route starting from grass that grows with little water all the way up to birds of prey flying in the sky.

3 **Find Similarities:**

Let's talk about whether there are any other animals that eat the animals at the top of the food chains.

Try

(1) Give one example of a top carnivore at the top of the food chain in the Nile River.

(2) If all the plants in the desert died out, what do you think would happen to the carnivores? Write your own thoughts.

Exercise

(1) Which statement correctly explains the food chains in Egypt? Choose the correct answer from below.

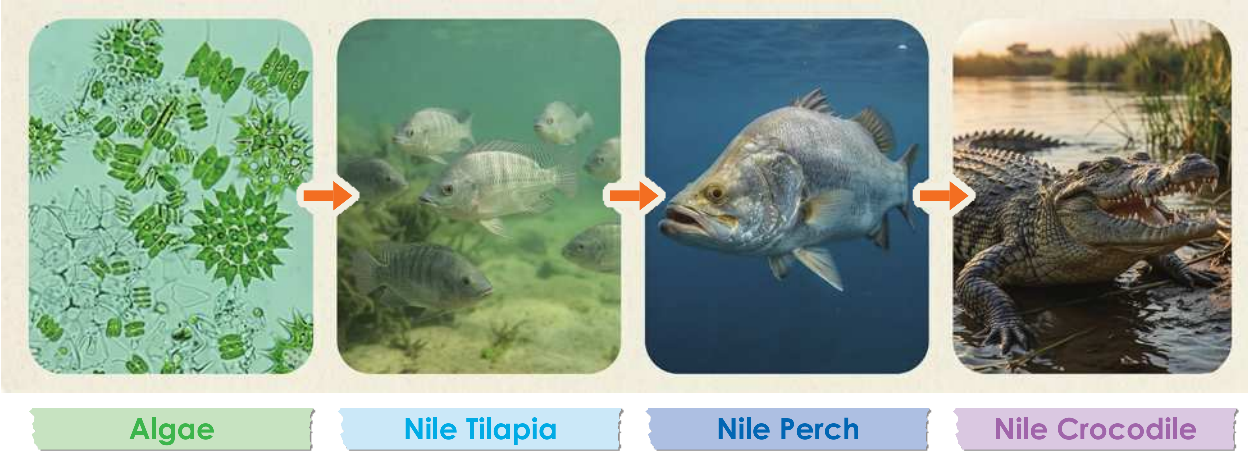
A: In the Nile River, crocodiles eat algae directly.

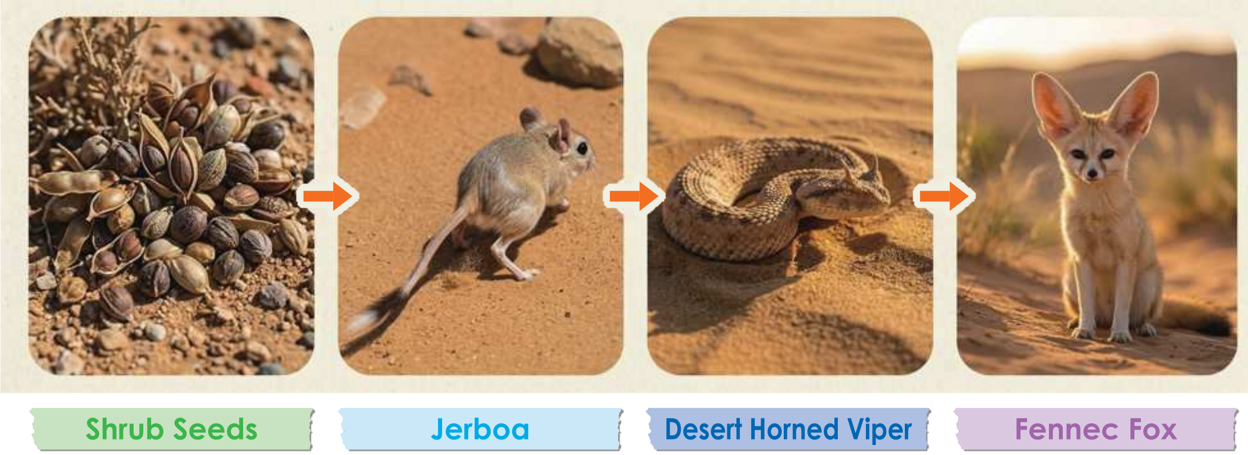
B: In the desert, fennec foxes eat small animals like jerboas.

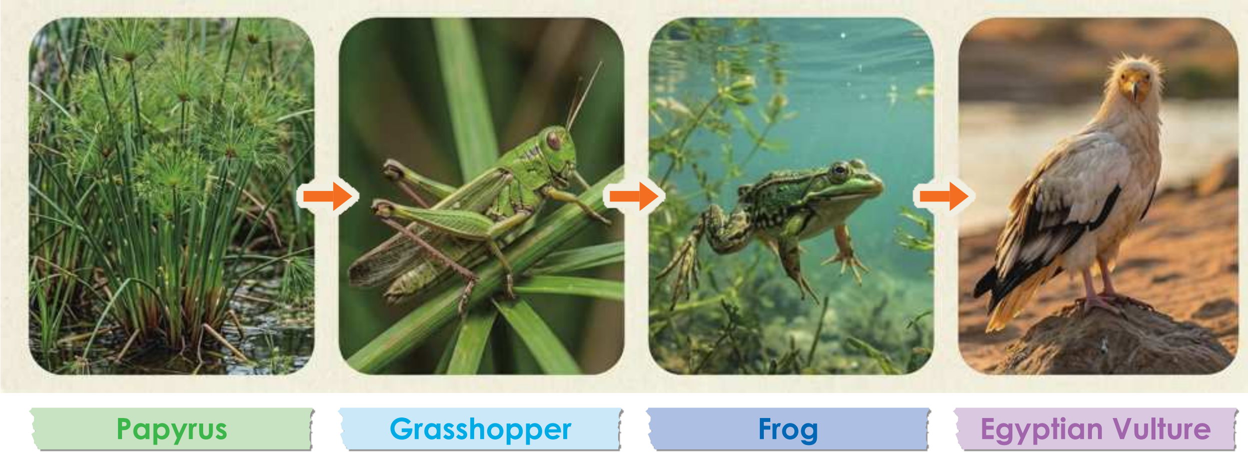
(2) Give one example of a herbivore that eats plants in the desert food chain.

Let’s Expand!

Let’s look at the food chains in Egypt.


Algae
Nile Tilapia
Nile Perch
Nile Crocodile


Shrub Seeds
Jerboa
Desert Horned Viper
Fennec Fox


Papyrus
Grasshopper
Frog
Egyptian Vulture

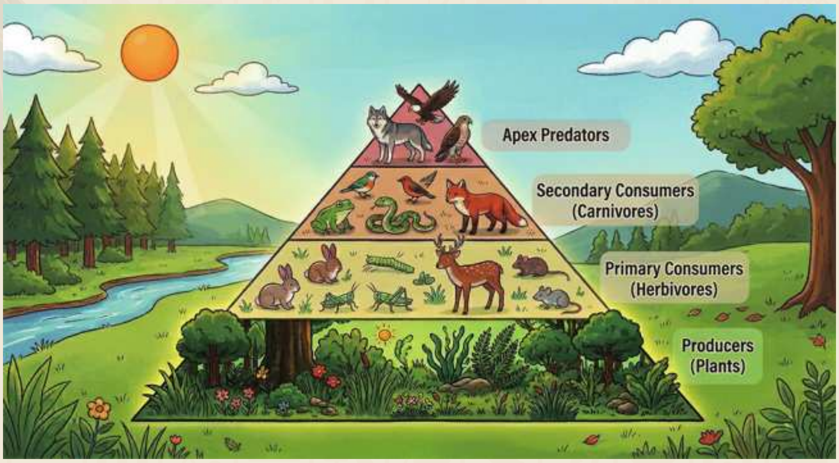
Chapter 8 Column: It Always Starts with "Plants"

1 It Always Starts with Plants

In Chapters 7 and 8, we learned about the food chain, where living organisms are connected by an "eat and be eaten" relationship.

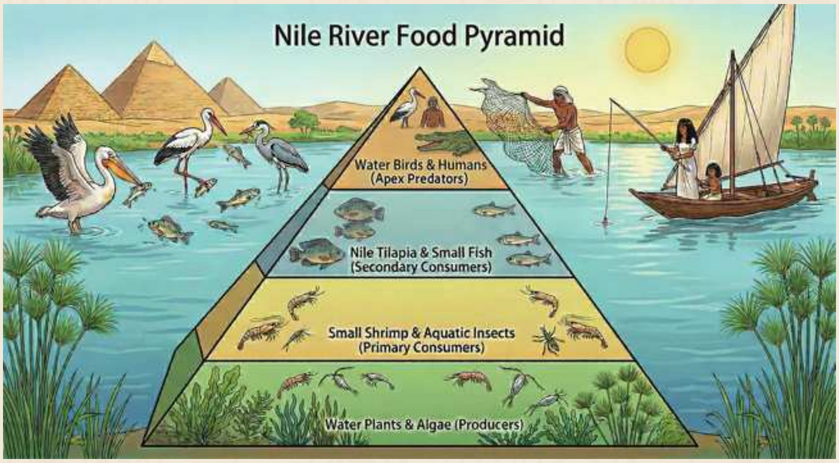
•The Base of the Pyramid:

The diagram of a food chain is called a food pyramid, and the very bottom of this pyramid is always supported by plants (producers), which produce their own food from sunlight.


Apex Predators
Secondary Consumers
(Carnivores)
Primary Consumers
(Herbivores)
Producers
(Plants)

•The Nile's Chain:

In the Nile River, there is a beautiful circle of life: small shrimp eat water plants, fish (like the Nile tilapia) eat the shrimp, and then water birds and humans eat the fish.


Nile River Food Pyramid
Water Birds & Humans
(Apex Predators)
Nile Tilapia & Small Fish
(Secondary Consumers)
Small Shrimp & Aquatic Insects
(Primary Consumers)
Water Plants & Algae (Producers)

2 Surviving in the Harsh Desert

The water flowing in Egypt is actually part of a "global cycle" that reaches all the way from countries far to the south.

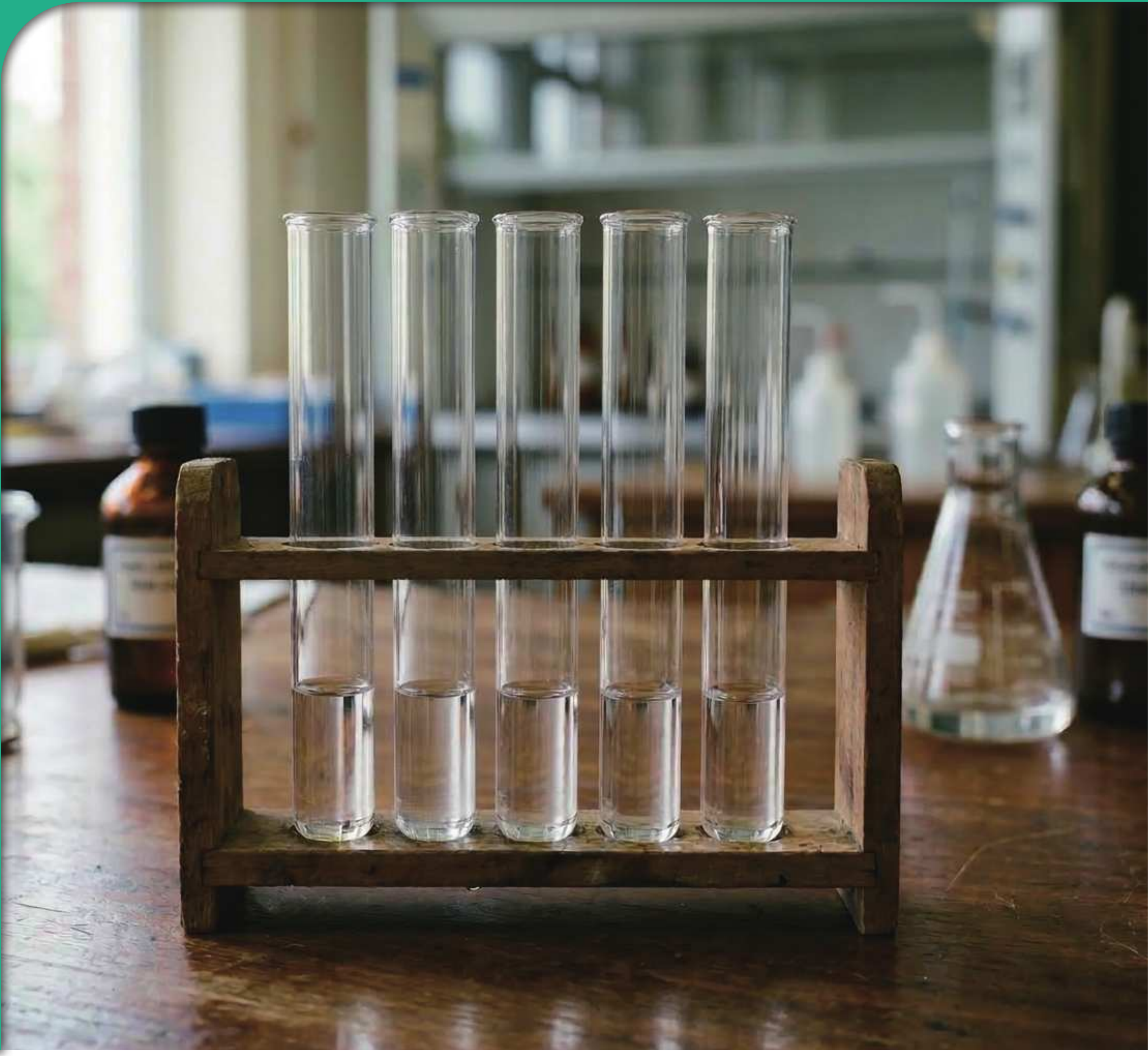
• The Desert Hunter Fennec Fox:

In the desert where there are few plants, animals that eat the small amount of grass seeds or lizards sustain the food chain. Without consumers like the fennec fox, the balance of the desert ecosystem would be disrupted.

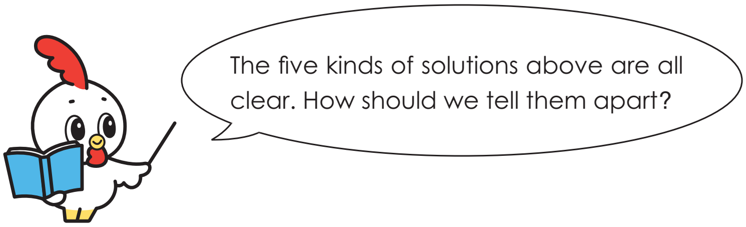
• Memories of Wadi al-Hitan:

Wadi al-Hitan, or the "Valley of the Whales," is a desert now, but it is filled with fossils from when it used to be an ocean. By studying this place, we can see that tens of millions of years ago, the ancient ocean had a complete food chain just like the Nile does today. From the past to the future, the connection of life remains unbroken.

9-1 Grouping Solutions



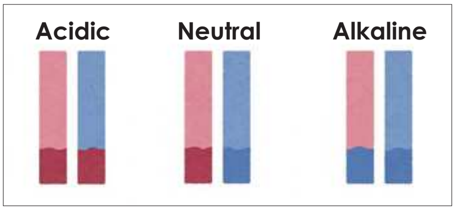
How can we group solutions?


The five kinds of solutions above are all clear. How should we tell them apart?

Point! Acidic, Neutral, and Alkaline

Solutions can be divided into 3 groups by how they change the color of litmus paper.

- Acidic: Turns **blue** litmus paper **red**.
  (Example: lemon juice, vinegar, hydrochloric acid)
- Neutral: Does **not change the color** of either litmus paper.
  (Example: salt water, sugar water, distilled water)
- Alkaline: Turns **red** litmus paper **blue**.
  (Example: soapy water, limewater, ammonia solution)



Warm Up Let's group solutions using litmus paper!

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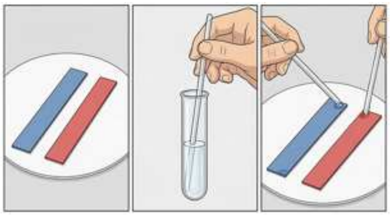
Let's use various solutions and observe the color changes.

1 Preparation:

- Solutions (salt water, carbonated water, dilute hydrochloric acid, baking soda solution, dilute ammonia solution)
- Beaker
- Tweezers
- Test tube
- Litmus paper
- Test tube rack
- Filter paper
- Glass rod
- Safety goggles

2 Experiment:



① Put blue and red strips of litmus paper on the filter paper.

② Use a glass rod to add one drop of the solution you want to test onto both litmus strips.

③ Check the color change of the litmus strips and group them into acidic, neutral, or alkaline.

[Caution!]

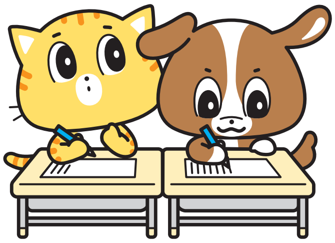
- When changing the solution, rinse the glass rod with water in a beaker and wipe it off every time.
- Make sure to ventilate the room. Also, wear safety goggles.

3 Summary: Let's summarize the results in a table.

9-2 What is dissolved in solutions

Chapter 9 ····· Properties of Solutions

How can we find out what is dissolved in a clear solution?



Can we take out what is dissolved from the solution?

Point! The Identity of Dissolved Substances

- By evaporating a solution, we can find out what was dissolved inside.
- Solids dissolved in water:

  When you evaporate the water, the dissolved substances (such as salt or baking soda) will remain at the bottom of the dish.
- Gases dissolved in water:
  - Even if you evaporate the water, **nothing will remain** because the dissolved substance escapes into the air. (Example: sparkling water)
  - Sparkling water has carbon dioxide gas dissolved in it.

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Warm Up Let's heat and extract what is dissolved!

Let's extract and observe what became invisible by dissolving in water.

1 Preparation:

- Solutions (salt water, carbonated water, dilute hydrochloric acid, baking soda solution, dilute ammonia solution)
- Beaker
- Test tube
- Test tube rack
- Pipette
- Evaporating dish
- Portable gas stove
- Wire gauze
- Safety goggles

2 Experiment:

❶ Use a pipette to transfer the solution from the test tube into the evaporating dish.
❷ Heat it gently over low heat with a portable gas stove.
❸ Turn off the heat while a little liquid is still left, and let the remaining heat dry it.
❹ Observe what is left.

[Caution!]

- During the experiment, do not bring your face close to the evaporating dish to smell it or breathe it in directly. When smelling, use your hand to waft the smell toward you.
- To avoid burns, do not touch heated objects until they cool down completely.

3 Summary:

- Let's summarize what was left in the evaporating dish in a table.
- Also, write down how the solutions look and smell.

Try

1 (1) Which is the correct combination for the litmus paper reaction? Choose the correct answer from below.

A: An alkaline solution turns red litmus paper blue.

B: An acidic solution turns red litmus paper blue.

C: A neutral solution changes the color of both litmus papers.

(2) What are some neutral solutions? Answer with one example.

2 (1) What are the white solid left at the bottom of the dish when salt water was evaporated?

(2) Why is nothing left at the bottom of the dish when dilute hydrochloric acid was evaporated? Choose the correct answer from below.

A: Because nothing was dissolved in the dilute hydrochloric acid.

B: Because what was dissolved escaped as a gas.

C: Because it melted from the heat.

Exercise

1 (1) What type of solution turns blue litmus paper red?

(2) Soap water turned red litmus paper blue. What kind of solution is soapy water? Choose the correct answer from below.

A: Acidic

B: Neutral

C: Alkaline

2 (1) What should you be careful of in the experiment to evaporate a solution? Choose the correct answer from below.

A: Keep heating on high heat until the bottom of the evaporating dish burns.

B: When smelling, breathe it in directly near the evaporating dish.

C: Turn off the heat when there is only a little solution.

(2) Which of the following solutions leaves nothing behind when evaporated? Choose the correct answer from below.

A: Sugar water

B: Dilute ammonia solution

C: Salt water

(3) What is dissolved in carbonated water?

Chapter 9 Column: The "Chemical Eye" That Sees Invisible Forces

1 The Secret of Solutions and the Pharaoh's Wisdom

Water solutions may look clear, but they hide mysterious properties — being acidic, neutral, or alkaline — that can only be told apart using litmus paper. The wisdom to control these properties has been in Egypt for thousands of years, cleverly used as a magic powder called natron to help make mummies.

- **Natural Alkaline Powder "Natron":**

Ancient Egyptians used a white powder called natron, found in desert salt lakes, which was strongly alkaline. It had a powerful ability to absorb water from the body, making it an essential material for creating mummies that kept their shape for thousands of years.

- **Acids and Alkalis in Our Daily Lives:**

Even today, we use the power of these properties without realizing it, such as lemon juice (acidic) for cooking and soapy water (alkaline) for cleaning.

2 Diagnosing the Earth and the Nile

In modern Egypt, testing the properties of water solutions is an important diagnostic tool to understand the current condition of the land and the Nile River. The color change of litmus paper is a scientific language that helps us read important messages from nature to protect our beautiful environment.

•The Health of the Soil for Growing Crops:

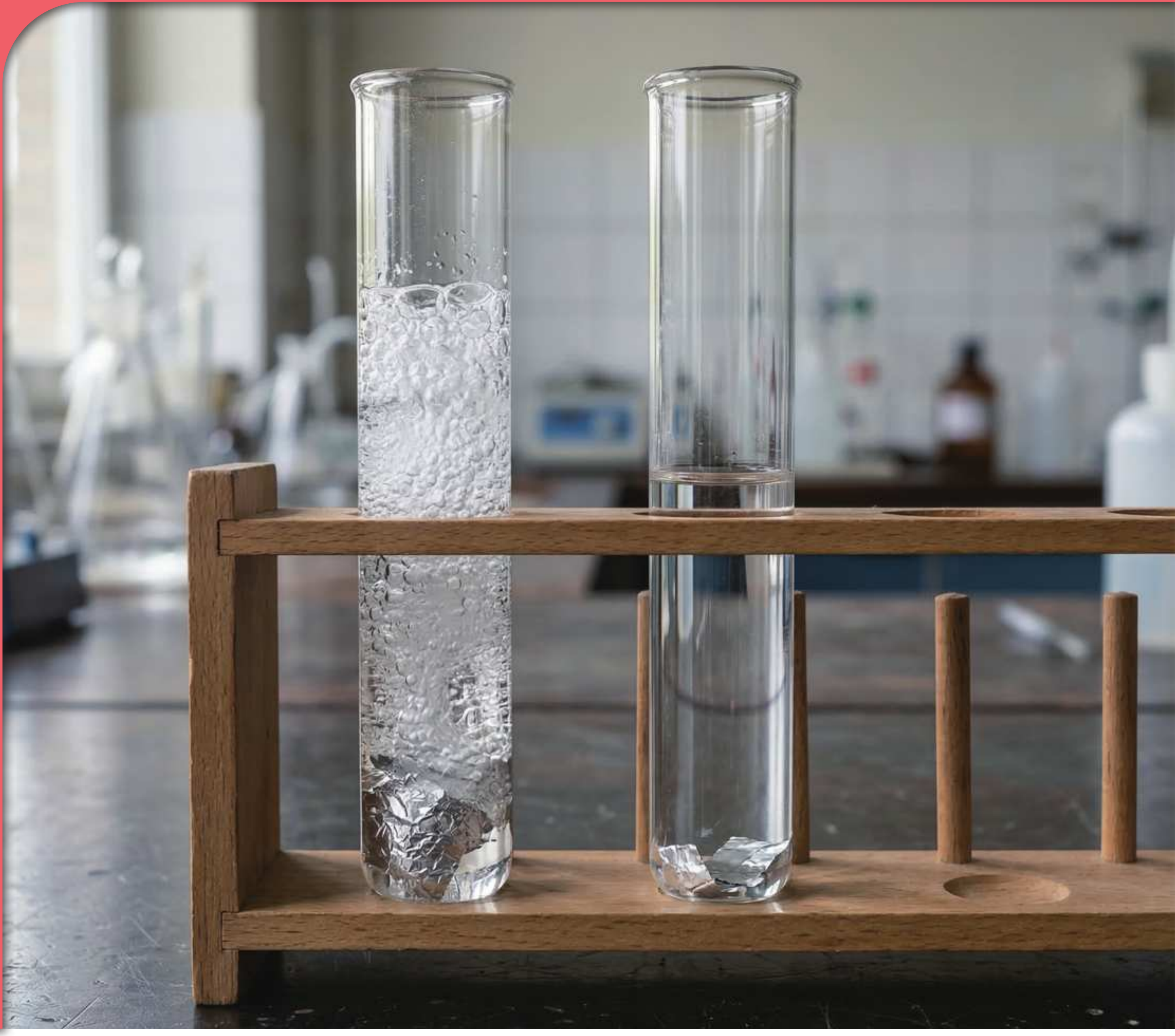
In the vast fields of Egypt, farmers are always checking whether the soil is acidic or alkaline. By adjusting the soil to the perfect condition for the plants they grow, like cotton and wheat, they cleverly ensure a large harvest of delicious crops.

•Water Quality Management of the Nile River:

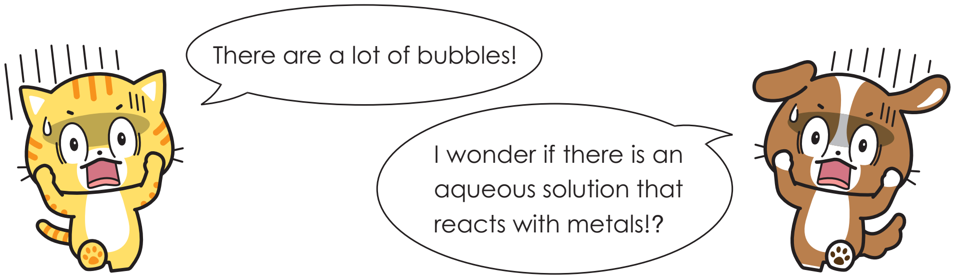
The quality of the Nile River, our water of life, is also scientifically monitored. Scientists carefully monitor wastewater from factories to ensure it is not strongly acidic or alkaline, using the power of science to protect a beautiful environment where fish and birds can live safely.

10-1 Aqueous Solutions and Metals

Chapter 10 ····· Reaction between Solutions and Metals



How do strong acidic or alkaline aqueous solutions act on metals?


There are a lot of bubbles!
I wonder if there is an aqueous solution that reacts with metals!?

Point! Properties that React with Metals

Some aqueous solutions have the properties that react with metals.

Hydrochloric acid has the properties that react with aluminum and iron. When you pour dilute hydrochloric acid on metals like aluminum and iron, the metals **react and produce bubbles**.

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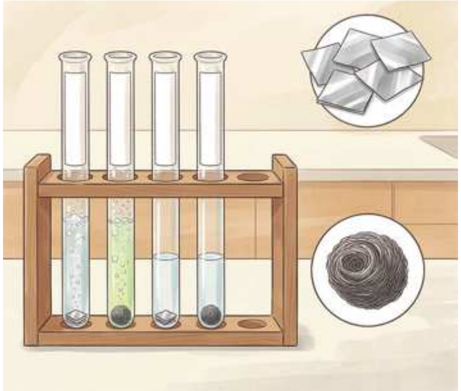
Warm Up Let's observe changes in metals!

Let's safely check how aqueous solutions react with metals.

1 Preparation:

- Dilute hydrochloric acid
- Aluminum
- Iron (Steel wool)
- Beaker
- Test tube
- Test tube rack
- Rag
- Pipette
- Safety goggles
- Water

2 Experiment:



① Cut aluminum into small pieces and put them in a test tube. Tear off a small amount of steel wool, roll it into a ball, and put it in another test tube. Prepare two test tubes for each.

② Use a pipette to add dilute hydrochloric acid to the first set of test tubes. And then use another pipette to add water to the second set of test tubes.

③ Observe the changes.

[Caution!]

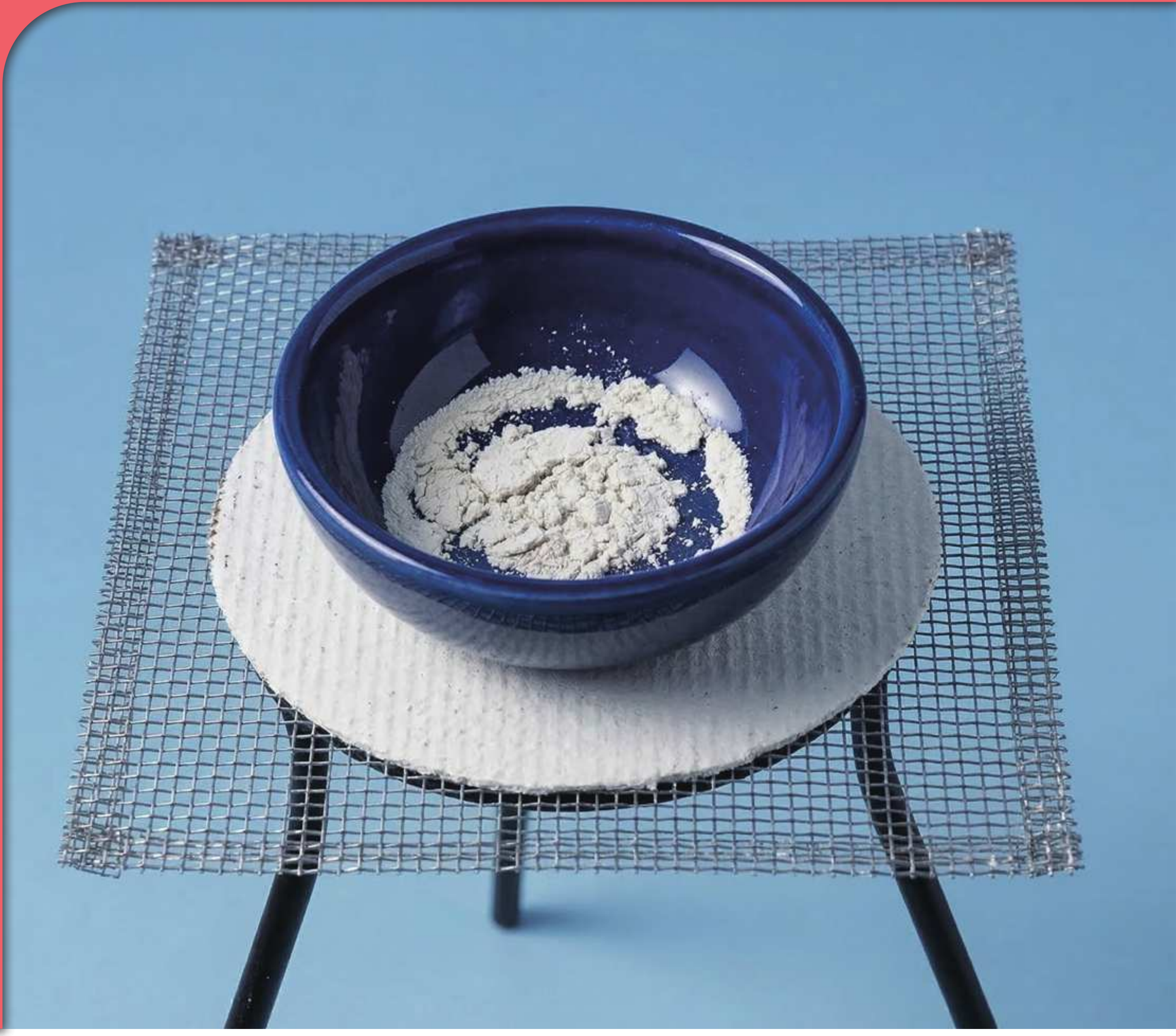
- Be careful not to let the liquid touch your skin. If it does, wash it off right away with running water.
- Make sure to ventilate the room. Also, wear safety goggles.

3 Summary:

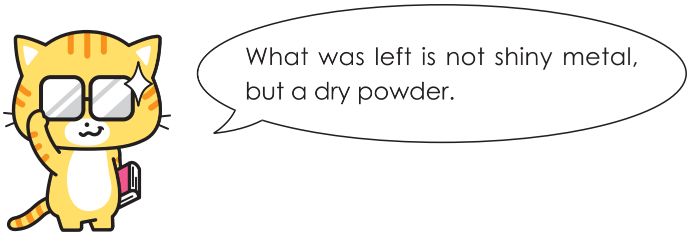
Let's summarize the results in a table.

10-2 What is Left After Evaporation

Chapter 10 ····· Reaction between Solutions and Metals



Let's evaporate the liquid in which the metal reacted and see if it is the same as the original metal.


What was left is not shiny metal, but a dry powder.

Point! Changes in Metals

When you evaporate the liquid of aluminum that reacted with dilute hydrochloric acid, a **white solid** appears.

Differences from the original metal:

- Appearance: It is not shiny.
- Reaction: Even if you put the remaining solid into dilute hydrochloric acid again, it will not react and produce bubbles like the original metal.

→ We can say that the metal changed into a **substance with completely different properties** by reacting with the aqueous solution.

Warm Up Let's test what the powder really is!

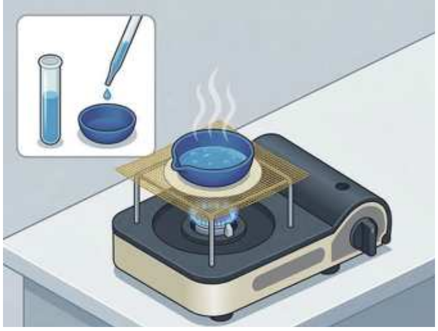
53 54

Let's extract and observe what disappeared when it dissolved in water.

1 **Preparation:**

- The liquid made in the previous lesson
- Beaker
- Test tube
- Test tube rack
- Pipette
- Evaporating dish
- Portable gas stove
- Wire gauze
- Safety goggles
- Dilute hydrochloric acid

2 **Experiment:**



1. Put the liquid in which the metal reacted into an evaporating dish.
2. Heat it gently on low heat with a portable gas stove.
3. Turn off the heat while there is still a little liquid left, and let the remaining heat dry it.
4. Observe what is left.
5. Try putting the powder you took out into dilute hydrochloric acid in another test tube. Check that no bubbles come out.

[Caution!]

- During the experiment, do not bring your face close to the evaporating dish or breathe in the fumes directly.
- To avoid burns, do not touch heated items until they have cooled down completely.
- Do not touch the remaining solid directly with your hands.

3 **Summary:** Let's summarize the differences from the original metal in a table.

Try

(1) What happens to metals like aluminum and iron when you pour dilute hydrochloric acid on them?

(2) What do you think happened to the metal that reacted with the aqueous solution? Choose the correct answer from below.

A: It is just hiding and remains as a metal.

B: It reacted with the aqueous solution and changed into something with different properties.

(3) Which statement is correct about the experiment after the metal reacted? Choose the correct answer from below.

A: When evaporated, the original shiny metal comes back.

B: The powder left after evaporation is a different substance from the metal.

Exercise

(1) Which statement correctly explains the properties of aqueous solutions that react with metals? Choose the correct answer from below.

A: Hydrochloric acid reacts with iron, but does not react with aluminum.

B: Hydrochloric acid can react with aluminum and iron.

(2) Is the powder left after evaporating the dilute hydrochloric acid with which aluminum reacted the same as the original aluminum?

(3) When you pour dilute hydrochloric acid again on the powder that appeared after evaporation, are bubbles produced?

Review & Practice

Let's solve the summary questions about the properties of aqueous solutions.

(1) What property does an aqueous solution have that turns blue litmus paper red? Choose the correct answer from below.

A: Acidic B: Neutral C: Alkaline

(2) When red litmus paper turns blue, what property can you tell the aqueous solution has? Choose the correct answer from below.

A: Acidic B: Neutral C: Alkaline

(3) What is the gas dissolved in carbonated water?

(4) What is left when you heat the dilute hydrochloric acid with which aluminum reacted in an evaporating dish? Choose the correct answer from below.

A: A white solid that is not a metal

B: The original shiny aluminum

C: Nothing is left.

(5) What happens when you pour dilute hydrochloric acid again on the powder remaining after evaporation? Choose the correct answer from below.

A: It explodes.

B: It reacts and produces bubbles just like the original metal.

C: No bubbles are produced.

(6) Which statement is correct about the phenomenon of metals reacting with aqueous solutions? Choose the correct answer from below.

A: The metal is just changing its shape, and its properties have not changed.

B: The metal changed into a substance with different properties.

(7) What is the last thing you should do for safety in the experiment of evaporating an aqueous solution? Choose the correct answer from below.

A: Turn off the heat while a little liquid is still left.

B: Keep heating on high heat until it is completely dry.

Column: The Science of Change-How Metals are Reborn

1 The Mystery of Gold That Shines Forever

The chemical reaction where strong, hard metals react with an acid and produce bubbles gives us an important clue about Egypt's proud golden history. Figuring out the true nature of the violent changes we saw in the experiment is the key to solving the mystery of why the Pharaoh's mask continues to shine even after thousands of years.

- **Why the Pharaoh Chose Gold:**

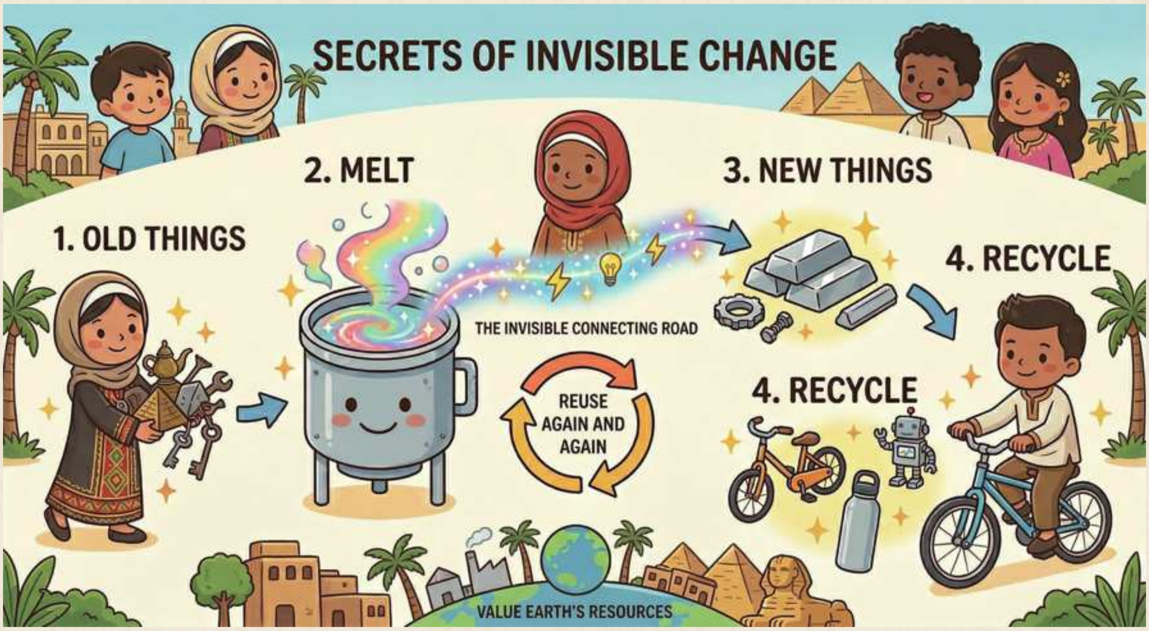
  The reason Tutankhamun's golden mask is still beautiful today is because gold has an extremely stable property — it does not react with strong solutions like hydrochloric acid.

- **The Energy Released When Metals React:**

  The bubbles that are produced when iron or aluminum reacts with dilute hydrochloric acid are actually hydrogen gas. When a metal changes into another substance, a large amount of chemical energy is at work to create a new gas.

2 The Power of Recycling to Reuse Resources

The process where a metal reacts with a solution and then is left behind in a different form after the solution evaporates proves that the substance has not disappeared from the world. This ability to understand “invisible changes” is incredibly useful in modern factories and in the world of recycling, where we use the Earth’s limited resources over and over again.


SECRETS OF INVISIBLE CHANGE
1. OLD THINGS
2. MELT
3. NEW THINGS
4. RECYCLE
THE INVISIBLE CONNECTING ROAD
REUSE AGAIN AND AGAIN
4. RECYCLE
VALUE EARTH'S RESOURCES

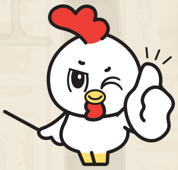
- **The Technology of Evaporating to Recover:**

The technology of evaporating water from a solution containing the reacted metal to extract the solid is used in factories to make very pure materials.

- **Egypt’s Future and Recycling:**

Instead of throwing away old metal items, we can use the power of chemistry to turn them back into clean materials. The rules of change you have learned will be a great power to reduce trash and make Egypt’s future green and ri

Even if a metal reacts and becomes invisible, its original parts are still hidden inside. How to take them out and reuse them — that is where the future scientists will show their skills!



Lab Safety and Professional Tools

In 6th-grade experiments, we handle fire and strong chemicals (like hydrochloric acid). This is a guide to help you do experiments safely and get the correct results.

1 Handling Chemicals

- **Wear safety goggles:**

  Always wear them to keep solutions like hydrochloric acid from getting into your eyes.

- **How to smell chemicals:**

  Waft the smell toward you with your hand. Do not put the chemical too close to your nose.

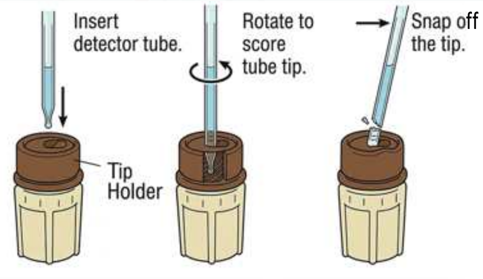
- **If you spill a chemical:**

  Wash it off right away with lots of water and tell your teacher.

2 How to Use a Gas Detector Tube

❶ Snap off both ends:

Use the special tip holder to snap off both ends of the detector tube.

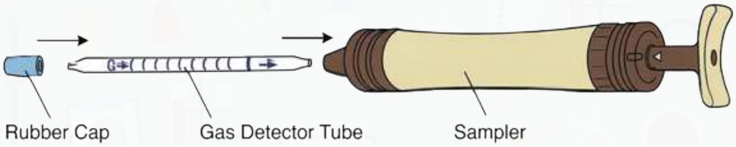

Insert detector tube.
Tip Holder
Rotate to score tube tip.
Snap off the tip.

❷ Check the arrow and attach the tube:

Push the detector tube firmly into the opening of the gas sampler so the arrow (→) points toward the sampler.

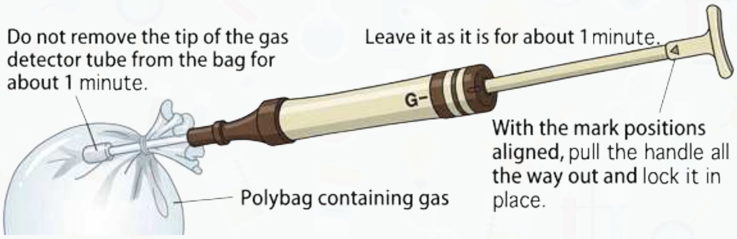
[Caution!]

- Always put on the rubber cap so you do not get hurt by the broken glass edges.


Rubber Cap
Gas Detector Tube
Sampler

❸ Draw in the gas and wait:

Pull the handle all the way out at once and lock it in place. Wait for the required time (about 1 minute).


Do not remove the tip of the gas detector tube from the bag for about 1 minute.

Leave it as it is for about 1 minute.

With the mark positions aligned, pull the handle all the way out and lock it in place.

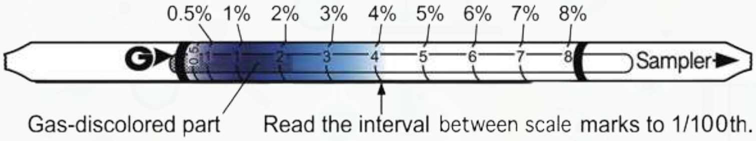
Polybag containing gas

❹ Read the scale:

Read the scale where the color has changed.

[Caution!]

- Oxygen detector tubes get hot, so do not touch them right away.
- Throw away used detector tubes exactly as your teacher tells you.


0.5%
1%
2%
3%
4%
5%
6%
7%
8%
Sampler
Gas-discolored part

Read the interval between scale marks to 1/100th.

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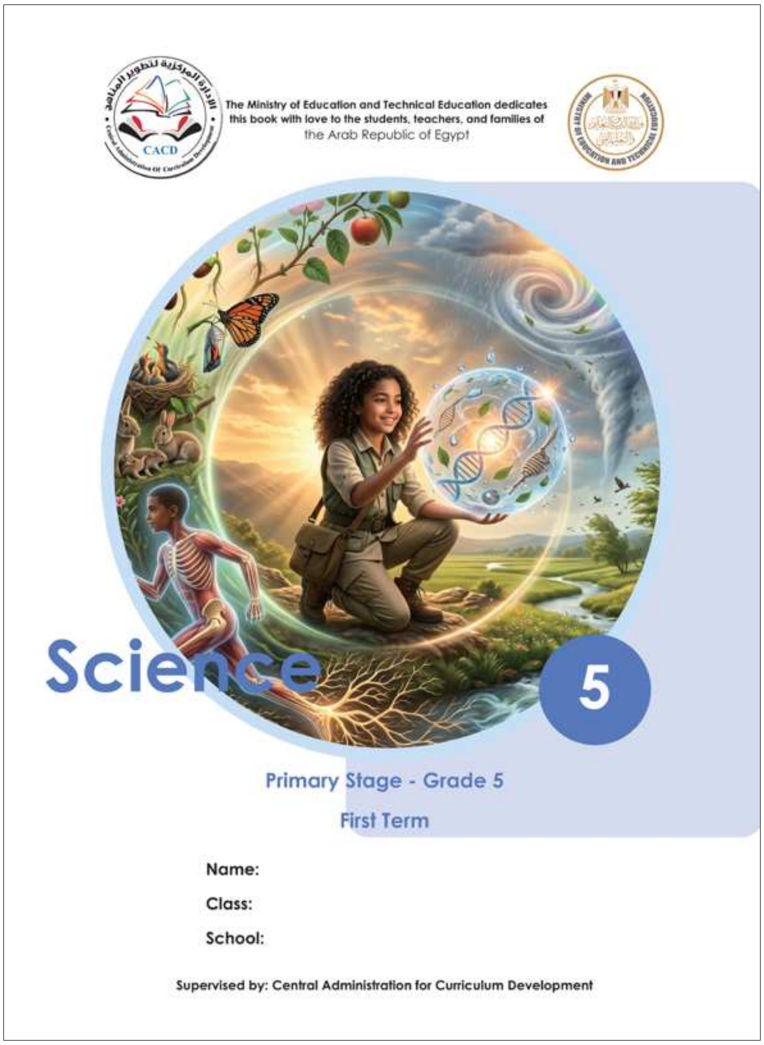

The Ministry of Education and Technical Education dedicates this book with love to the students, teachers, and families of the Arab Republic of Egypt

Science 5

Primary Stage - Grade 5

First Term

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حمل التطبيق الأن

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